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# RESEARCH MEMORANDUM

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WITH TWO DIFFERENT SPINNERS AND AN NACA D-TYPE

COWL AT MACH NUMBERS UP TO 0.80

By George C. Kenyon and Robert M. Reynolds

Ames Aeronautical Laboratory Moffett Field, Calif.

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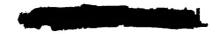
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NATIONAL ADVISORY COMMI FOR AERONAUTICS

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### NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

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#### SUMMARY

An investigation has been made to determine the aerodynamic characteristics of a three-blade propeller designed to operate ahead of a D-type cowl. The propeller (designated NACA 3.638-(675)(057)-0572) in combination with two different spinner shapes and an NACA 1-62.8-070 D-type cowl was investigated at Mach numbers up to 0.80. The characteristics of the isolated propeller-spinner combination operating at positive thrust, negative thrust, and at near static conditions were also determined. Included are results of air-stream surveys of the local velocities in the plane of the propeller. All tests were made with the model at an angle of attack of 0° and at a Reynolds number of 1,000,000 per foot, based on free-stream conditions.

The efficiency of the propeller in the presence of the cowl was higher at all Mach numbers than that of the isolated propeller-spinner combination. At design cruise conditions (M=0.60,  $\beta=53^{\circ}$ ), the efficiency of the propeller with the 1-series spinner and cowl was 80 percent, as compared with 72 percent for the isolated propeller-spinner combination. The onset of marked compressibility losses was delayed from a Mach number of 0.50 to a Mach number of 0.60 by the addition of the cowl.

The effects of inlet velocity ratio and spinner shape on the propeller characteristics were not large except at the higher Mach numbers (0.70 and 0.80).

### INTRODUCTION

Considerable research has been conducted on propeller-spinner-cowling combinations suitable for use with large turbine engines (refs. 1 to 5). To augment this research, an investigation was conducted in the Ames



12-foot pressure wind tunnel to determine the characteristics of a three-blade propeller and a D-type cowl with both an NACA 1-series spinner and a more nearly conical spinner. The pressure-recovery characteristics of these propeller-spinner-cowling combinations have been reported in reference 6. Reference 7 has presented some preliminary results for the propeller with the cowl and spinners.

Presented herein are results of force tests, obtained concurrently with the data presented in reference 6, for the propeller operating in the presence of the cowl with the two different spinners. Also presented are force-test results for the isolated propeller-spinner combination operating at positive thrust, negative thrust, and at near static conditions. The velocity distributions in the plane of the propeller are included.

The tests were conducted for a range of blade angles from  $-20^{\circ}$  to  $63^{\circ}$  and at Mach numbers up to 0.80. All tests were made with the model at an angle of attack of  $0^{\circ}$  and at a Reynolds number of 1,000,000 per foot, based on free-stream conditions.

### NOTATION

speed of sound blade width power coefficient,  $\frac{P}{on^{S_{0}5}}$ thrust coefficient,  $\frac{T}{on^2D^4}$ Ст  $e_{l_{\mathbf{d}}}$ blade-section design lift coefficient propeller diameter D HP horsepower maximum thickness of blade section h advance ratio,  $\frac{V_0}{nn}$ J Mach number,  $\frac{V}{8}$ M tip Mach number,  $M\sqrt{1+\left(\frac{\pi}{J}\right)^2}$ M<sub>+</sub>



- n propeller rotational speed
- P power
- R propeller-tip radius
- r blade-section radius
- S propeller disc area
- T thrust
- $T_c$  thrust coefficient,  $\frac{T}{\rho V^2 D^2}$
- U local velocity in the plane of the propeller
- V air-stream velocity
- $V_{\rm O}$  equivalent free-air velocity
- $\frac{V_1}{V_2}$  inlet velocity ratio
- β propeller blade angle at 0.75 R
- $\beta_d$  design propeller-section blade angle
- $\eta$  efficiency,  $\frac{C_T}{C_P}$  J
- ρ air density

## Subscripts

- 1 location of rake in cowl inlet
- a apparent (applied to propeller characteristics when operating ahead of the cowl)

#### MODEL AND APPARATUS

This investigation was conducted in the Ames 12-foot pressure wind tunnel with the model mounted on the 1000-horsepower dynamometer (described in ref. 8). A photograph of the model is presented in figure 1 and a sketch of the general model arrangement is given in figure 2. The propeller used was a three-blade type designed by Hamilton Standard Division and



it corresponded to the designation NACA 3.638-(675)(057)-0572. Blade-form curves for the propeller are shown in figure 3. Additional details of the model and its instrumentation as well as information on the full-scale design conditions can be found in reference 6.

Figure 4 is a photograph of the survey rake used to determine the velocity distribution in the plane of the propeller. The rake consisted of 24 static pressure tubes located at the radial stations listed in table I.

## TESTS AND REDUCTION OF DATA

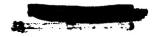
Thrust, torque, and rotational speed were measured (as described in refs. 2 and 8) for the propeller-spinner-cowl combinations and the isolated propeller-spinner combination (1-series spinner) for a range of blade angles from 33° to 63° at Mach numbers from 0.20 to 0.80. Data for the isolated propeller-spinner combination were obtained at negative thrust conditions at the same Mach numbers and blade angles and, in addition, data were obtained for this combination at a Mach number of 0.15 for blade angles from -20° to 25°. The characteristics of the isolated propeller-spinner combination were also measured at near static conditions for a blade-angle range from 10° to 25°.

Surveys of the air-stream velocity in the plane of the propeller were made at Mach numbers from 0.15 to 0.80. With the cowl installed, the effect of inlet velocity ratio on the local velocity in the propeller plane was also determined.

The Mach number used in this report was the average Mach number over the disc area as determined by velocity surveys reported in reference 8. For the tests made with the cowl installed, this Mach number (and the corresponding dynamic pressure) was corrected for blockage of the cowl by the method of reference 9. In no case did this correction exceed 1 percent.

The air-stream velocity (and, consequently, propeller advance ratio and efficiency) was corrected for the wind-tunnel-wall constraint on the propeller slipstream by the method of reference 10. Figure 5 presents a comparison of this correction with that determined experimentally by the method of reference 11 from measurements of wall pressures. The data included herein are for advance ratios at which the thrust-coefficient parameter  $T_{\rm C}/(1-M^2)$  was greater than -0.5.

Analysis of the accuracy of the separate measurements of thrust, torque, and air-stream velocity, as in reference 8, indicates that errors in the propeller efficiencies reported herein are probably less than 2 percent.





#### RESULTS

The distribution of velocity across the propeller disc is listed in table I. These data are plotted in figure 6 for a few typical Mach numbers and inlet velocity ratios.

The characteristics of the propeller operating in the presence of the cowl are presented in figures 7 and 8 and the characteristics of the isolated propeller-spinner combination for conditions of positive thrust are presented in figure 9. The variation of maximum propeller efficiency with Mach number is summarized in figure 10 and the effect of inlet velocity ratio on the propeller characteristics is shown in figure 11.

The negative-thrust characteristics of the propeller-spinner combination are presented in figures 12 through 15 and the characteristics of the propeller-spinner combination at near static conditions are shown in figure 16 and are summarized in figure 17.

### DISCUSSION

## Propeller Characteristics at Positive Thrust

As in reference 2, the characteristics of the propeller operating in the presence of the cowl are presented as apparent values (figs. 7 and 8) since the determination of the propulsive thrust of the propeller was precluded by the fact that it was impractical, with the dynamometer arrangement used in the present investigation, to measure the increase in drag of the cowl and dynamometer parts within the influence of the propeller slipstream. The addition of the cowl behind the propeller resulted in reduced velocities throughout the propeller flow field, as evidenced by a comparison of figures 6(a) and 6(b) with figure 6(c). As a consequence of these reduced velocities (and in accord with the discussion of ref. 12), the thrust and power for the propeller operating ahead of the cowl were greater than that for the isolated propeller-spinner combination (at the same advance ratio), as can be seen from a comparison of figures 7 and 8 with figure 9.

Maximum efficiency.- As shown in figure 10, the efficiency of the propeller in the presence of the cowl was higher at all Mach numbers than that of the isolated propeller-spinner combination. At design cruise conditions (M = 0.60,  $\beta$  = 53°), the efficiency of the propeller with the 1-series spinner and cowl was 80 percent, as compared with 72 percent for the isolated propeller-spinner combination. It may be noted here that the higher efficiencies for the propeller with the cowl were due not only to interference effects but partly to the fact that, in the presence of



the cowl, the propeller was operating more nearly in the flow field for which it was designed.

The onset of marked compressibility losses was delayed (also as a consequence of the interference effects) from a Mach number of 0.50 to a Mach number of 0.60 by the addition of the cowl (fig. 10). The large losses in efficiency at Mach numbers from 0.60 to 0.80 were due not only to the effects of compressibility but also to the fact that at blade angles of  $58.5^{\circ}$  and  $63^{\circ}$  the inner portions of the blades were probably operating at negative thrust, since the local blade angles for this portion of the blade were greater than  $90^{\circ}$  (up to  $98^{\circ}$  for  $\beta = 63^{\circ}$ ). Operation of the propeller at lower blade angles at these Mach numbers (requiring higher rotational speeds) might have resulted in higher efficiencies but was not permissible because of structural limitations of the model propeller.

Effect of inlet velocity ratio. Although the air-stream surveys (tables I(a) and I(b), and figs. 6(a) and 6(b)) show that decreasing inlet velocity ratio resulted in reduced local velocities at the propeller plane, the changes were small in comparison with the reduction in velocity occasioned by the addition of the cowl to the spinner (fig. 6(a) compared with fig. 6(c)). Consequently, as shown in figures 7, 8, and 11, the effect of inlet velocity ratio on the propeller characteristics was not large except at the higher Mach numbers (0.70 and 0.80), where small changes in local velocity resulted in relatively large changes in the propeller characteristics due to the effects of compressibility.

Effect of spinner shape. Although the data of figures 6(a) and 6(b) indicate only small differences in the local velocity distributions for the two spinners with the propeller removed, figure 11 shows that higher thrust and power coefficients were obtained with the propeller and modified conical spinner. However, as shown in figure 10, the differences in maximum efficiency were generally of the order of the stated accuracy of the results.

# Propeller Characteristics at Negative Thrust

The data presented in figure 14(a) indicate that at any constant value of advance ratio, relatively constant negative-thrust coefficients were attained at blade angles from -5° to -20°. However, as shown in figure 15(a), the power coefficients corresponding to this range of blade angles increased rapidly, indicating that use of a more negative blade angle resulted in additional power absorption rather than an increase in negative thrust. For the range of blade angles and Mach numbers covered in the present investigation, there was practically no effect of compressibility on the negative-thrust and torque characteristics of the propeller at Mach numbers up to 0.60 (see figs. 14 and 15).



## Propeller Characteristics at Near Static Conditions

The thrust and torque characteristics presented in figures 16(a) and 16(b) were obtained at near static conditions, as shown by the variation of velocity with nD in figure 16(c). The abrupt decrease in thrust coefficient and increase in power coefficient at values of nD below 60 are believed to be due to the effects of Reynolds number. At these low values of nD, the blade sections were operating at Reynolds numbers less than about 500,000.

The experimental data shown in figure 16 were used to compute the static thrust per horsepower and were then plotted as a function of power disc loading for constant values of nD. The envelope of these curves is presented in figure 17. The theoretical curve shown in figure 17 was computed by the method of reference 13. The variation of static thrust per horsepower with disc loading was adequately predicted by the theory, but the experimental values were only approximately 67 percent of the theoretical ideal values. However, the theory neglects rotational losses and blade drag which presumably accounts for the discrepancy between experiment and theory.

#### CONCLUDING REMARKS

The following remarks may be made regarding the results of the subject investigation.

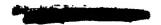
The efficiency of the propeller with the two different spinners and the cowl was higher at all Mach numbers than that of the isolated propeller-spinner combination. At design cruise conditions (M = 0.60,  $\beta = 53^{\circ}$ ), the efficiency of the propeller with the 1-series spinner and cowl was 80 percent, as compared with 72 percent for the isolated propeller-spinner combination.

The onset of marked compressibility losses was delayed from a Mach number of 0.50 to a Mach number of 0.60 by the addition of the cowl.

The effects of inlet velocity ratio and spinner shape on the propeller characteristics were not large except at the higher Mach numbers (0.70 and 0.80).

There was practically no effect of compressibility on the characteristics of the propeller-spinner combination operating at negative thrust at Mach numbers through 0.60.





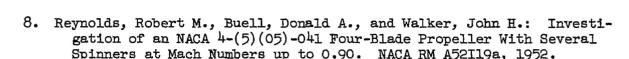
The propeller static thrust varied with power disc loading as predicted by actuator disc theory, but the experimental static thrust was only 67 percent of the theoretical ideal thrust.

Ames Aeronautical Laboratory
National Advisory Committee for Aeronautics
Moffett Field, Calif., Feb. 18, 1954

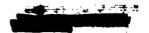
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# TABLE I.- LOCAL VELOCITY RATIO, U/V

# (a) The 1-series spinner with cowl

Radial	м - 0.20						N = 0.40						И = 0.50								
station,	Inlet velocity ratio, V₁/V					Inlet valocity ratio, √1/V					Inlat velocity ratio, V1/V										
in.	0.52	0.56	0.58	0.67	0.85	1,02	1.36	0735	0-40	0.52	0.61	0.80	1.00	1.33	0.29	0.39	0.50	0.60	9.80	1,00	1.31
3.44	0.912	0.922	0.917	0.940	0.997	0.963	0.983	0.908	0.913	0.923	0.948	0.965	0.963	0.981	0.892	0.906	0.916	0.936	0.953	0.965	0.91
3.69	.916	.916	-916	.941	-951	.962	.982	901	-912	.919	,9 <b>4</b> 2	-952	.962	.952	889	.905	.913	-935	840.	-958	-97
3,94	.912	.916	.911	.936	946	.962	-977	.899	-909	-912	.939	.949	-951	-962	.883	.900	-907	.927	عاو.	-954	90
4.19	.901	.906	.911	.926	.936	.972	962	.892	-902	-907	.924	-937	-917	-954	.875	-892	-896	.919	-932	944	-9.
4.44	.905	-905	.910	-925	-935	9,0	.961	.899	-902	-909	.927	-937	.917	952	.881	.894	.900	-919	.929	.942	-9.
4.94	-900	-905	905	.920	-930	-936	956	.693	.901	-906	.918	.926	.936	علو	.879	.886	-896	-909	.923	-927	-90
5.44	.914	.909	-91	.924	-934	-935	915	898	.908	.911	923	-928	-936	940	.889	-098	-902	.915	-9e3	.929	9
5.94	-993	-993	-918	.928	-936	-939	.944	.903	.916	.923	.931	.931	.939	942	.901	-909	-913	-921	-927	-933	.91
6.44	.923	-983	-923	.928	.939	939		,919	-918	-923	-931	.941	.939	942	903	-911	-913	.991	925	-931	.9
7. kh 8. hh	.947	-947	940	976	917	.953 .962	.948	935	935	-933	.940				939	926	-986	939	-939	-941	
9.44	-956	.956	.976 .966	966	.956 .976		971	95	-957	.957 .967	-979	-929	.959 .967	-962	923		-947	931	-953 -963	.953 .961	-9.
10.44	.966			.900	.980	.971	975		-967	.970	-959	-970	.970	-972	965	-977	-957		965	-967	3
19.44	.989	975	.975 .989	975	.964	.975 .979	979	.972	970 978	.978	.969 .980	.988	.978	972	.971	-963	·965	.963	.976	.978	9
14.44	.987	987	987	.962	982	.982	.977	.989	984	.984	987	.987	.984	-990	.975	-973	-965	983	-963	.985	9
16.14	.991	.991	.991	.966	-986	.986	.981	.986	981	981	.983	.984	.980	989	981	981	-903	961	.961	.984	9
16.44		.990	.990	.985	985	.990	.990	.988	.988	.988	.988	988	.986	996	.980	.986	966	.984	984	.986	1 .6
20.14	.990	.990	.990	.990	.990	995	.995		.992		.995	-993	.593	993	.986	.969	.990	000	.990	.992	.99
22.44	.989	.909	.969	.984	984	989	.909	993	.909	993	991	.989	992	.992	-991	.987	.987	-9 <del>8</del> 9	.987	.987	9
24.44	999	999	.999	ook	.994	.999	.000	999	.993	993	.996	998	.996	.996	994	.992	.992	990	999	.992	.99
26.44	-993	.993	.988	.903	988	.993	.999 .986	-997	-995	995	997	-995	995	.995	990	.990	990	.994	.994	.994	.9
28.14	993	-993	-993	993	-993	.998	993	.996	996	996	996	996	994	996	991	.993	.994	993	-993	993	9
30.44	-993	993	998	-998	993	998	.998	995	-993	-995	-995	995	-993	-993	.987	-991	-991	.991	989	.991	
32.44	.997	997	-997	-997	997	-999	-997	-999	.999	.999	996	.997	.997	-999	994	-999	.998	.996	.998	.998	95
									-												
		1sl N = 0.60						N = 0.70					и = 0.60								
1 2	adial	l			x - 0.6	0					H -	0.70					и -	0.80			
	tation,		Ъ				1/4			Inlet		v retic	, V <sub>1</sub> /V			Inlet	_	ty reti	o, V <sub>1</sub> /V	,	1
		0.32	D 0.41	let vel			1.03	1.26	0.32	Inlet			, V <sub>1</sub> /V	1.07	0.32	Inlet 0.41	_		0.82		
	in.	-	0.41	1et vel 0.52	ocity r	0.84	1.03	-		0.41	velocit	0.67	0.82	-		0.41	7#loci	0.62	0.82	0.96	
	in.	0.898	0.41	0.52 0.936	0.62 0.937	0.84 0.953	0.964	0.971	0.897	0.41	0.51 0.926	0.67 0.936	0.82	0.957	0.681	0.41	0.51 0.916	0.62 0.927	0.82	0.96	
	3.44 3.69	0.898	0.41 0.914 .908	0.52 0.936	0.62 0.937 •933	0.84 0.953 950	0.964 0.979	0.971	0.897	0.41 0.915 .912	0.51 0.52 0.926 925	0.67 0.936 -933	0.82	0.957 957	0.881	0.41 0.905 .905	0.51 0.916 .915	0.62 0.927 .936	0.82	0.96 0.946	
	3.14 3.69 3.94	0.898 .898 .891	0.41 0.914 .908	0.52 0.936 .926	0.62 0.937 .933	0.84 0.953 .950 .943	1.03 0.964 .979 .930	0.971 .966	0.897 .892 .885	0.41 0.915 .912 .906	0.51 0.52 0.926 925 916	0.67 0.936 .933	0.82 0.946 .946	0.957 957 945	0.681 .877 .672	0.41 0.905 .905 .896	0.51 0.916 .915	0.62 0.927 .936 .915	0.82 0.942 .936 .928	0.96 0.946 .944	
	3.14 3.69 3.94 4.19	0.898 .898 .891 .863	0.41 0.914 .908 .905	0.52 0.936 .926 .925	0.62 0.937 .933 .988 .916	0.84 0.953 .950 .943	1.03 0.964 .999 .950 .938	0.971 .966 .954	0.897 .892 .885 .874	0.41 0.915 .912 .906 .894	0.51 0.926 .925 .916 .905	0.67 0.936 .933 .924 .911	0.82 0.946 .946 .935 .923	0.957 -957 -945 -933	0.881 .877 .872 .860	0.41 0.905 .905 .896 .886	0.51 0.916 .915 .905	0.62 0.927 .936 .915	0.82 0.942 .936 .928 .914	0.96 0.946 .944 .932	
	3.44 3.69 3.94 4.19 4.45	0.898 .898 .891 .863 .886	0.41 0.914 .908 .905 .895 .897	0.52 0.936 .926 .925 .914	0.62 0.937 .933 .988 .916	0.84 0.953 .950 .943 .931	1.03 0.964 .979 .930 .936 .940	0.971 .966 .954 .947	0.897 .892 .885 .874 .879	0.41 0.915 .912 .906 .894 .895	0.51 0.52 0.926 .925 .916 .905	0.67 0.936 .933 .924 .911	0.82 0.946 .946 .935 .923	0.957 .957 .945 .933	.877 .877 .860 .860	0.41 0.905 .905 .896 .886 .885	0.51 0.916 .915 .905 .895 .894	0.62 0.927 .936 .915	0.82 0.942 .936 .928 .914 .911	0.96 0.946 .944 .932 .920 .922	
	3.44 3.69 3.94 4.19 4.45	0.898 .898 .891 .863 .886 .883	0.41 0.914 .908 .905 .895 .897 .893	0.936 .926 .926 .926 .914 .917	0.62 0.937 .933 .988 .916 .916	0.84 0.953 .950 .943 .931 .929	1.03 0.964 .979 .930 .940 .931	0.971 .966 .954 .947 .945	0.897 .892 .885 .874 .879	0.915 .912 .906 .894 .895	0.51 0.52 0.926 .925 .916 .905 .905	0.67 0.936 .933 .924 .911 .911	0.82 0.946 .946 .935 .923 .923	9.957 .957 .945 .933 .931	0.881 .877 .872 .860 .860	0.kt 0.905 .905 .896 .886 .885	0.51 0.916 .915 .905 .895 .894	0.62 0.927 .936 .915 .905 .904 .896	0.82 0.942 .936 .928 .914 .901	0.96 0.946 .932 .920 .922 .920	
	3.44 3.69 3.94 4.19 4.45 4.94 5.44	0.898 .898 .891 .863 .886 .883 .891	0.41 0.914 .908 .909 .899 .897 .893	0.936 .926 .926 .926 .914 .917 .910	0.62 0.937 .933 .988 .916 .916 .911	0.953 -950 -943 -931 -989 -926 -924	1.03 0.964 .979 .930 .936 .940 .931	0.971 .966 .954 .947 .945	0.897 .892 .885 .874 .879 .871	0.41 0.915 .912 .906 .894 .895 .886	0.51 0.926 .925 .916 .905 .905 .995 .895	0.67 0.936 .933 .924 .911 .905	0.82 0.946 .946 .935 .923 .923 .914	9.957 .957 .945 .933 .931 .982	0.881 .877 .872 .860 .860 .857	0.41 0.905 .905 .896 .886 .885 .877	0.51 0.916 .915 .905 .895 .894 .886	0.62 0.927 .936 .915 .905 .904 .896 .893	0.82 0.942 .936 .928 .914 .901	0.96 0.946 .944 .932 .980 .922 .910	
	3.44 3.69 3.94 4.19 4.45 4.94 5.44	0.898 .898 .891 .863 .886 .883 .891	0.41 0.914 .908 .909 .899 .897 .893 .898	0.52 0.936 .926 .926 .928 .914 .917 .910 .910	0.62 0.937 .933 .988 .916 .916 .911 .911	0.953 -950 -943 -931 -929 -926 -924 -929	1.03 0.964 .979 .930 .936 .940 .931 .928	0.971 .966 .954 .947 .945 .933 .933	0.897 .892 .885 .874 .879 .874 .882	0.41 0.915 .912 .906 .894 .895 .886 .891	0.51 0.926 .925 .916 .905 .905 .899 .899	0.67 0.936 .933 .924 .911 .911 .909	0.62 0.946 .946 .935 .923 .923 .914 .913	9.957 9.957 9.953 9053 9053 9053 9053 9053 9053 9053 9	0.881 .877 .872 .860 .860 .877 .863 .868	0.41 0.905 .905 .896 .886 .885 .877 .878	0.51 0.916 .915 .905 .895 .894 .886 .886	0.6e 0.927 .936 .915 .905 .904 .896 .893 .897	0.82 0.942 .936 .928 .914 .904 .904	0.96 0.946 .944 .932 .920 .922 .910 .910	
	3.44 3.69 3.94 4.19 4.45 4.94 5.44 5.94	0.898 .898 .891 .863 .886 .883 .891 .903	0.41 9.90 905 .895 .897 .893 .898 .907	0.52 0.936 .926 .926 .928 .914 .917 .910 .910 .919	0.62 0.937 .933 .928 .916 .916 .911 .916 .916	0.84 0.953 .950 .943 .931 .989 .986 .924 .989	1.03 0.964 .979 .950 .936 .940 .931 .928 .931	0.971 .966 .934 .947 .945 .933 .933	0.897 .892 .885 .874 .879 .878 .882 .891	0.41 0.915 .912 .906 .894 .895 .886 .891 .897	0.51 0.926 .925 .916 .905 .905 .895 .899 .905	0.67 0.936 .933 .924 .911 .911 .905 .908	0.62 0.946 .946 .935 .923 .923 .914 .913 .916	957	0.881 .877 .872 .860 .860 .857 .863 .868	0.41 0.905 .905 .896 .886 .885 .877 .878 .895 .886	0.51 0.916 .915 .905 .895 .894 .886 .886 .891	0.62 0.927 .936 .915 .905 .905 .904 .896 .893 .897	0.82 0.942 .936 .928 .914 .904 .904	0.96 0.946 .944 .932 .920 .922 .910 .910	
	3.44 3.69 3.94 4.19 4.45 4.94 5.44 7.44	0.898 .898 .891 .883 .886 .883 .891 .903 .905	0.41 0.914 .908 .905 .895 .897 .893 .898 .907 .912	0.52 0.936 .926 .926 .914 .917 .910 .919 .921	0-62 0-937 -933 -988 -916 -911 -911 -916 -936	0.84 0.953 .950 .953 .931 .989 .986 .924 .989 .989	1.03 0.964 .979 .950 .936 .940 .931 .928 .931 .938	0.971 .966 .954 .947 .955 .935 .935 .938	0.897 .892 .885 .874 .879 .874 .892 .891	0.41 0.915 .912 .906 .894 .895 .886 .891 .897 .896	0.51 0.52 0.926 .927 .916 .907 .907 .899 .907 .907	0.67 0.936 .933 .924 .911 .905 .908 .907	0.62 0.946 .946 .935 .923 .923 .914 .913 .916 .914	9.957 9.957 9.953 9.951 9.959 9.959 9.959	0.881 .877 .872 .860 .860 .857 .863 .868 .873	0.41 0.905 .905 .896 .886 .885 .877 .878 .895 .586	0.51 0.916 .915 .905 .895 .896 .886 .886 .891 .891	0.62 0.927 .936 .915 .905 .904 .896 .893 .897 .897	0.82 0.942 .936 .928 .914 .904 .904 .906 .908	0.96 0.946 .932 .920 .922 .910 .910 .910	
	3.44 3.69 4.19 4.94 5.44 5.44 5.44 5.44	0.898 .898 .891 .863 .886 .883 .891 .903 .905	0.41 0.914 .908 .905 .897 .897 .893 .598 .907 .912	0.52 0.936 .926 .926 .934 .917 .910 .910 .920 .920 .950	0-62 0-937 -933 -968 -916 -916 -911 -916 -916 -916 -916 -916	0.84 0.953 .950 .943 .931 .989 .926 .928 .929 .938	1.03 0.964 .979 .936 .940 .931 .931 .931 .938 .938	0.971 .966 .974 .947 .937 .933 .935 .935	0.897 .892 .885 .874 .879 .874 .892 .891 .892 .912	0.41 0.915 .912 .906 .894 .895 .886 .891 .897 .898 .916	0.51 0.926 .925 .916 .905 .905 .899 .905 .905 .905 .905 .905 .905 .905	0.67 0.936 .933 .924 .911 .905 .908 .907	0.82 0.946 .946 .935 .923 .914 .913 .916 .914 .925	9.957 9.957 9.953 9.951 9.959 9.959 9.959 9.959	0.881 .877 .872 .860 .860 .857 .863 .868 .873 .896	0.41 0.905 .905 .886 .885 .877 .878 .895 .895 .900	0-51 0-915 -915 -905 -895 -894 -886 -886 -891 -891 -993	ty ret! 0.62 0.927 .936 .915 .905 .904 .896 .893 .897 .907	0.82 0.942 .936 .928 .914 .901 .904 .905 .905 .902 .902 .908	0.96 0.946 .944 .932 .920 .920 .910 .910 .916 .935	
	3.44 3.69 4.19 5.44 5.44 7.44 7.44 9.44	0.898 .898 .891 .883 .886 .883 .991 .903 .905 .945	0.41 0.914 .908 .909 .899 .899 .893 .596 .907 .912 .926	0.52 0.936 .926 .926 .917 .910 .919 .921 .940 .956	0-62 0-937 -933 -946 -946 -911 -916 -916 -936 -936 -936 -937 -939	0.84 0.953 -950 -953 -953 -953 -964 -965 -969 -969 -969	1.03 0.964 979 950 930 931 931 931 931 938 931 936 936	0.971 .966 .9947 .947 .937 .937 .938 .938 .938	0.897 .892 .885 .874 .879 .874 .892 .891 .892 .918 .933	0.41 0.915 .912 .906 .894 .895 .885 .897 .898 .916 .936	0.51 0.52 0.52 0.926 925 925 925 925 895 925 925 925 925 925 925 925 925 925 9	7 retio 0.67 0.936 .933 .924 .911 .905 .908 .908 .907 .929 .939	0.82 0.946 .946 .935 .963 .914 .914 .916 .914 .925 .940	0.957 .957 .933 .933 .939 .939 .939 .939 .939	0.881 .877 .872 .860 .860 .857 .863 .868 .873 .896	0.41 0.905 .905 .896 .885 .887 .878 .889 .886 .900 .921 .939	0.51 0.51 0.916 .915 .905 .896 .886 .886 .891 .891 .891 .923	ty rets 0.62 0.927 .936 .915 .904 .896 .893 .897 .907 .907 .908	0.82 0.942 .936 .928 .914 .904 .904 .905 .902 .912 .928 .944	0.96 0.946 .944 .932 .920 .910 .910 .910 .910 .930 .930 .930	
	3.44 3.69 3.94 4.19 4.45 5.94 7.44 7.44 9.44	0.898 .898 .891 .863 .886 .883 .991 .905 .905 .926 .945 .945	0.41 0.914 .908 .909 .899 .897 .893 .598 .907 .912 .926 .946 .961	0.52 0.936 .926 .926 .914 .917 .910 .920 .921 .940 .950 .967	0-62 0-937 -933 -968 -916 -911 -911 -916 -916 -926 -926 -926 -926 -926 -926 -926 -92	0.84 0.953 .970 .943 .931 .989 .984 .989 .989 .989 .989 .989	1.03 0.964 .979 .930 .940 .931 .988 .931 .931 .935 .936 .936 .966	0.971 .966 .994 .947 .945 .935 .935 .935 .938 .938 .964	0.897 .892 .885 .874 .874 .892 .891 .892 .913 .911 .972	0.41 0.915 .915 .906 .895 .886 .891 .897 .898 .916	0.51 0.52 0.52 0.52 0.526 0.525 0.50	7 retio 0.67 0.936 .933 .924 .911 .905 .908 .907 .928 .939 .939	0.82 0.946 .946 .935 .923 .914 .913 .916 .914 .925 .949 .959	0.957 .957 .933 .933 .934 .939 .939 .939 .939 .939	0.881 .877 .862 .860 .863 .863 .873 .896 .921 .937	0.41 0.905 .905 .896 .885 .877 .878 .889 .886 .900 .921 .939	0-51 0-916 -915 -907 -895 -894 -886 -891 -891 -923 -929 -939	ty ret! 0.62 0.927 .936 .915 .905 .904 .896 .893 .897 .907	0.82 0.942 .928 .924 .904 .904 .904 .905 .902 .912 .942 .942	0.96 0.946 .944 .922 .920 .910 .910 .910 .935 .948	
	3.44 3.69 4.19 4.44 5.44 7.44 7.44 10.44	0.898 .898 .891 .863 .886 .883 .991 .905 .905 .926	0.41 0.914 .908 .909 .899 .897 .893 .996 .907 .912 .926 .941 .961	0.52 0.936 .926 .926 .914 .917 .910 .920 .921 .940 .950 .967	0.62 0.937 .933 .926 .916 .911 .916 .916 .930 .939 .939 .939	0.84 0.953 .953 .953 .931 .989 .986 .989 .989 .989 .989 .989 .989	1.03 0.964 -979 -930 -930 -931 -931 -931 -938 -931 -938 -936 -966 -977	0.971 .966 .974 .947 .937 .933 .933 .938 .938 .964 .964	0.897 .892 .885 .874 .879 .878 .892 .913 .913 .933 .931 .976 .964	0.41 0.915 .912 .906 .895 .886 .891 .897 .898 .916 .936	**Nocition of the control of the con	7 retto 0.67 0.936 .933 .924 .911 .911 .905 .908 .907 .922 .939 .954	0.82 0.946 .946 .935 .923 .914 .913 .916 .914 .925 .950 .950	\$2.50 \$2.50	0.881 .877 .860 .860 .860 .873 .868 .873 .937 .937 .936	0.41 0.905 .905 .896 .885 .877 .878 .885 .886 .900 .921 .939 .939	0-51 0-916 -915 -907 -895 -894 -886 -891 -891 -923 -929 -939	ty ret! 0.6e 0.927 .936 .915 .904 .896 .893 .897 .907 .928 .940 .940	0.82 0.942 .936 .928 .914 .904 .904 .905 .902 .912 .928 .944	0.96 0.946 .934 .932 .920 .920 .910 .910 .916 .937 .948 .948	
	3.44 3.69 3.94 4.19 4.54 5.44 5.44 9.44 10.44 11.44	0.898 .898 .893 .886 .883 .891 .905 .905 .945 .945 .962 .989	0.41 0.914 .908 .909 .899 .899 .896 .907 .912 .926 .941 .961 .973	0.52 0.936 .926 .926 .914 .917 .910 .920 .921 .940 .950 .967	0.62 0.937 .933 .968 .916 .911 .911 .916 .930 .949 .959 .964 .968	0.84 0.953 .950 .943 .931 .989 .984 .989 .989 .989 .989 .989 .989	1.03 0.964 .979 .930 .936 .940 .931 .931 .931 .938 .931 .936 .964 .964	0.971 .966 .974 .947 .937 .933 .933 .938 .938 .964 .964	0.897 .892 .885 .874 .879 .878 .892 .991 .933 .931 .976 .964 .976	0.41 0.915 .906 .894 .895 .886 .897 .898 .916 .936 .936 .936 .936	**Nocition of the control of the con	7 retio 0.67 0.936 .933 .924 .911 .905 .908 .907 .928 .939 .939	0.82 0.946 .946 .937 .963 .914 .913 .914 .925 .940 .953 .959 .959	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	0.881 .877 .860 .860 .863 .863 .873 .863 .921 .937 .946 .952	0.kt 0.905 .905 .886 .885 .877 .876 .886 .900 .921 .939 .939 .939	0.51 0.915 0.915 .905 .895 .886 .886 .891 .891 .923 .938	ty reti 0.62 0.927 .936 .915 .905 .905 .893 .897 .897 .990 .940 .940 .940	0.82 0.942 .928 .924 .904 .904 .906 .902 .912 .942 .942 .942	0.96 0.946 .944 .922 .920 .910 .910 .910 .935 .948	
	3.44 3.69 4.19 4.44 5.44 7.44 7.44 10.44	0.898 .898 .891 .863 .886 .883 .903 .905 .945 .945 .962 .962 .968	0.41 0.914 .908 .909 .899 .899 .896 .907 .912 .926 .941 .961 .973	0.92 0.936 .926 .926 .917 .910 .919 .921 .940 .957 .968	0.68 0.937 .933 .968 .916 .916 .916 .916 .916 .936 .936 .939 .939 .939 .938 .938	0.84 0.953 .953 .953 .931 .989 .986 .989 .989 .989 .989 .989 .989	1.03 0.964 -979 -930 -930 -931 -931 -931 -938 -931 -938 -936 -966 -977	0.971 .966 .974 .947 .949 .933 .933 .933 .938 .964 .964	0.897 .892 .885 .874 .879 .878 .892 .913 .913 .933 .931 .976 .964	0.41 0.915 .912 .906 .895 .886 .891 .897 .898 .916 .936	**Nocition of the control of the con	7 retio 0.67 0.936 .933 .924 .911 .905 .904 .907 .922 .939 .934 .939 .934 .939	0.82 0.946 .946 .935 .963 .914 .914 .916 .914 .925 .940 .970 .962	\$2.50 \$2.50	0.881 .877 .860 .860 .873 .868 .873 .966 .937 .946 .955 .965	0.la 0.905 .905 .896 .886 .887 .878 .885 .886 .900 .921 .939 .939 .939 .939 .939	0.51 0.916 .915 .995 .895 .896 .886 .891 .891 .923 .939 .939	ty ret! 0.62 0.927 .936 .915 .905 .905 .893 .897 .907 .909 .940 .940 .940 .940	0.82 0.942 .936 .928 .914 .901 .906 .902 .912 .944 .942 .942 .942 .943 .945 .945	0.96 0.946 .932 .920 .910 .910 .910 .935 .948 .948 .948 .955	
	3.44 3.69 3.94 4.94 5.54 5.54 7.44 10.44 11.44 11.44	0.898 .898 .891 .863 .886 .886 .993 .905 .945 .945 .946 .948 .968	0.41 0.914 .908 .909 .899 .899 .896 .907 .912 .946 .941 .961 .961	0.92 0.936 .926 .926 .926 .914 .917 .910 .910 .920 .930 .950 .967 .967	0-62 0-937 -933 -968 -916 -911 -911 -916 -930 -945 -968 -968 -969 -969	0.84 0.953 -970 -943 -931 -984 -984 -989 -938 -970 -962 -962 -962 -962 -962 -962 -962 -962	1.03 0.964 .979 .950 .940 .931 .931 .931 .938 .931 .936 .956 .966 .977 .962 .968	0.971 .966 .954 .947 .945 .935 .935 .938 .938 .964 .973 .962 .973	0.897 .892 .869 .874 .879 .874 .882 .892 .912 .933 .971 .976 .976	0.41 0.915 .912 .906 .894 .895 .886 .891 .898 .916 .936 .936 .936 .936 .938	**North Property (North Proper	7 retto 0.67 0.936 .933 .924 .911 .905 .908 .907 .929 .939 .939 .934 .931 .931 .931 .931 .931 .937 .938	0.82 0.946 .946 .935 .963 .914 .913 .916 .916 .925 .940 .973 .973 .977 .977	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	0.881 .877 .860 .860 .863 .868 .873 .896 .921 .934 .955 .970 .970	0.la 0.905 .905 .896 .886 .887 .878 .885 .886 .900 .921 .939 .939 .939 .939 .939	0.51 0.916 .915 .907 .895 .886 .886 .891 .891 .923 .928 .939 .939 .939 .939 .939	ty reti 0.62 0.927 .936 .915 .905 .896 .893 .897 .907 .940 .940 .940 .940 .940 .940 .940 .940	0.82 0.94s .936 .928 .904 .904 .906 .908 .944 .944 .927 .966 .970 .970 .970	0.96 0.944 .932 .920 .920 .930 .930 .930 .935 .935 .935 .937 .937 .937 .937 .937	
	3.44 3.69 3.94 4.19 5.44 4.94 5.44 10.44 116.44 116.44 120.44	0.898 .891 .883 .886 .883 .891 .905 .905 .905 .945 .945 .956 .958 .968 .968	0.41 0.914 .908 .909 .897 .893 .898 .907 .947 .960 .947 .960 .941 .980 .981	0.52 0.936 .926 .926 .926 .917 .910 .910 .921 .940 .956 .967 .973 .985 .985	0.62 0.937 933 986 916 916 916 916 916 916 916 916 916 91	0.84 0.953 .970 .943 .931 .986 .924 .989 .929 .938 .970 .962 .962 .973 .963 .963 .963	1.03 0.964 .979 .950 .940 .931 .931 .931 .938 .931 .936 .956 .966 .977 .962 .968	0.971 .966 .954 .947 .945 .935 .935 .938 .938 .964 .973 .962 .973	0.897 .892 .889 .879 .879 .878 .832 .891 .892 .913 .913 .976 .976 .976 .968	0.41 0.915 .912 .906 .894 .895 .886 .891 .896 .996 .996 .978 .978 .978	**North Property (North Proper	9 retio 0.67 0.936 .933 .924 .911 .905 .904 .905 .904 .907 .922 .939 .939 .954 .951 .961 .961 .961 .962	0.82 0.946 .946 .935 .963 .913 .914 .913 .914 .924 .950 .960 .974 .977 .970	\$\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	0.881 877 .872 .860 .863 .863 .873 .876 .937 .937 .946 .970 .978 .965	0.kt 0.905 .905 .886 .885 .877 .876 .886 .900 .921 .939 .939 .939	0.916 0.915 .915 .907 .894 .886 .886 .881 .891 .923 .923 .925 .926 .926 .927	ty reti 0.62 0.927 .936 .915 .904 .893 .897 .940 .940 .940 .939 .940 .957 .957 .957 .957 .957 .957 .957 .958	0.89 0.942 .936 .928 .911 .904 .904 .902 .912 .942 .942 .942 .977 .965 .971 .965	0.96 0.946 .932 .922 .920 .910 .910 .916 .936 .948 .948 .949 .957 .967 .978	
	3.44 3.69 3.94 4.94 5.84 5.84 7.84 9.44 12.44 12.44 18.44	0.898 .893 .891 .863 .883 .891 .903 .905 .945 .946 .962 .963 .968 .968	0.41 0.914 .908 .909 .899 .899 .898 .907 .947 .961 .971 .980 .981 .980 .984	0.92 0.936 .926 .926 .926 .917 .910 .910 .921 .940 .957 .967 .967 .969 .990	0.68 0.937 933 986 906 901 901 901 901 901 903 903 903 903 903 903 903 903 903 903	0.84 0.953 .950 .943 .939 .986 .984 .989 .989 .989 .962 .962 .962 .962 .963 .964 .962 .963 .964 .963 .963 .964 .964 .965 .966 .966 .966 .966 .966 .966 .966	1.03 0.964 979 970 930 931 931 931 936 931 936 970 964 968 968 969	0.971 .966 .974 .947 .947 .933 .933 .935 .938 .964 .964 .979 .989 .989 .989	0.897 .892 .889 .874 .879 .874 .882 .892 .933 .921 .972 .964 .976 .964	0.41 0.915 .912 .906 .894 .896 .896 .896 .996 .996 .978 .978 .978 .984 .984	**North Property of the control of t	9 retio 0.67 0.936 .933 .924 .911 .905 .908 .908 .908 .909 .939 .939 .939 .939 .939 .939 .939	0.82 0.946 .946 .935 .963 .914 .913 .916 .916 .925 .940 .973 .973 .977 .977	\$\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	0.88t .877 .860 .860 .857 .863 .873 .896 .972 .965 .978 .965 .978 .961 .984	0.kg 0.905 .905 .896 .885 .877 .878 .886 .900 .901 .939 .939 .957 .973 .964	0.51 0.916 .915 .907 .895 .886 .886 .891 .891 .923 .928 .939 .939 .939 .939 .939	ty reti 0.62 0.927 936 935 904 -896 -897 -907 -907 -908 -940 -968 -971 -963 -968 -968 -968 -968 -968 -968 -968 -968	0.89 0.942 .936 .928 .911 .904 .904 .902 .912 .942 .942 .942 .977 .965 .971 .965	0.96 0.944 .932 .920 .920 .930 .930 .930 .935 .935 .935 .937 .937 .937 .937 .937	
	3.44 3.69 3.99 4.44 4.54 4.54 4.54 10.44 11.44 1	0.898 .893 .883 .883 .883 .903 .905 .926 .945 .962 .968 .968 .968 .968	0.41 0.914 .908 .905 .897 .893 .896 .901 .926 .947 .961 .973 .980 .998 .998 .998	0.926 0.926 .926 .926 .926 .917 .917 .919 .921 .921 .950 .968 .967 .989 .989 .999	0.68 0.937 .933 .946 .916 .916 .911 .916 .916 .949 .949 .949 .949 .949 .949 .949 .94	0.84 0.953 0.950 0.953 0.931 0.989 0.986 0.989 0.989 0.989 0.962 0.962 0.962 0.963 0	1.03 0.964 .979 .950 .940 .931 .931 .931 .938 .931 .936 .956 .966 .977 .962 .968	0.971 .966 .974 .947 .937 .935 .935 .936 .964 .964 .964 .973 .989 .989	0.897 .892 .885 .874 .874 .892 .891 .992 .933 .971 .976 .964 .968	0.41 0.915 .912 .906 .894 .895 .886 .891 .896 .996 .996 .978 .978 .978	**North Property (North Proper	7 ratio 0.67 0.936 933 924 911 905 908 907 922 934 95 95 95 95 97 97 98 98 97 98 97 98 97 98 97 98 97 98 98 97 98 98 98 98 98 98 98 98 98 98 98 98 98	0.82 0.946 .945 .923 .923 .924 .913 .914 .925 .940 .925 .940 .925 .940 .925 .940 .925 .940 .925 .940 .925 .940 .925 .940 .925 .946 .925 .925 .925 .925 .925 .925 .925 .925	\$\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	0.881 877 .872 .860 .863 .863 .873 .876 .937 .937 .946 .970 .978 .965	0.la 0.905 .905 .866 .887 .877 .878 .886 .900 .921 .939 .939 .939 .939 .973 .973 .979 .979	0.51 0.916 .915 .925 .895 .886 .891 .891 .891 .939 .939 .939 .970 .976 .966	ty reti 0.62 0.927 .936 .915 .904 .893 .897 .940 .940 .940 .939 .940 .957 .957 .957 .957 .957 .957 .957 .958	0.88 0.942 936 931 901 906 908 908 94 94 94 94 95 96 97 98 98 98 98 98 98 98 98 98 98	0.96 0.944 .932 .922 .910 .910 .910 .935 .948 .957 .957 .957 .958 .966 .986	
	3.44 3.69 3.49 4.49 4.44 10.44 110.44 110.44 110.44 110.44 110.44 110.44 110.44 110.44 110.44 110.44 110.44 110.44	0.898 .898 .891 .883 .883 .891 .903 .903 .905 .945 .962 .968 .989 .989 .989	0.41 0.914 .908 .909 .899 .899 .898 .907 .947 .961 .971 .980 .981 .980 .984	0.52 0.936 .926 .926 .927 .917 .910 .920 .920 .940 .950 .967 .961 .993 .993 .993	0-62 0-937 -933 -946 -916 -916 -916 -916 -930 -949 -949 -968 -968 -979 -968 -968 -968 -968 -968 -968 -968 -96	0.84 0.953 .950 .943 .989 .989 .989 .989 .989 .989 .989 .98	1.03 0.964 979 930 930 931 931 931 931 931 936 937 966 977 968 988 990 988	0.971 .966 .974 .947 .947 .933 .933 .935 .938 .964 .964 .979 .989 .989 .989	0.897 .892 .885 .874 .874 .882 .891 .993 .991 .976 .976 .979 .984 .967 .969	0.41 0.915 912 906 .895 .895 .897 .896 .916 .978 .978 .978 .978 .978 .989 .989 .989	***Incit to 1.51	7 ratio 0.67 0.936 .933 .921 .911 .905 .908 .907 .929 .939 .939 .939 .939 .939 .939 .939	0.82 0.946 .946 .935 .963 .914 .913 .914 .925 .940 .950 .966 .988 .988	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	0.881 .877 .860 .860 .863 .863 .863 .863 .965 .965 .965 .965 .965 .965 .965 .965	0.kg 0.905 .905 .896 .885 .877 .878 .886 .900 .921 .939 .939 .957 .979 .984 .986	0.51 0.915 .915 .895 .894 .886 .886 .891 .891 .923 .923 .929 .925 .926 .926 .936 .936 .936 .936 .936 .936 .936 .93	ty reti 0.62 0.927 936 935 904 -896 -897 -907 -907 -908 -940 -968 -971 -963 -968 -968 -968 -968 -968 -968 -968 -968	0.89 0.942 .936 .928 .911 .904 .904 .902 .912 .942 .942 .942 .977 .965 .971 .965	0.96 0.944 .932 .922 .910 .910 .916 .935 .942 .957 .967 .978 .978 .978	
	3.44 3.69 3.19 3.59 4.59 4.59 4.59 4.59 4.50 10.44 116.44	0.898 .893 .883 .883 .883 .903 .905 .926 .945 .962 .968 .968 .968 .968	0.41 0.914 .908 .905 .897 .893 .898 .907 .912 .947 .961 .961 .960 .980 .980 .985 .986 .989 .989	0.926 0.926 .926 .926 .926 .917 .917 .919 .921 .921 .950 .968 .967 .989 .989 .999	0.68 0.937 .933 .946 .916 .916 .911 .916 .916 .949 .949 .949 .949 .949 .949 .949 .94	0.84 0.953 0.950 0.953 0.931 0.989 0.986 0.989 0.989 0.989 0.962 0.962 0.962 0.963 0	1.03 0.964 .979 .930 .940 .931 .931 .931 .931 .935 .964 .965 .965 .968 .989 .990 .999	0.971 .966 .974 .947 .937 .933 .933 .938 .964 .973 .962 .973 .982 .973 .982 .973 .982 .983	0.877 .892 .885 .874 .879 .874 .892 .913 .933 .911 .954 .964 .968 .967 .968	0.41 0.915 .912 .906 .894 .895 .895 .916 .916 .926 .928 .938 .978 .978 .984 .978 .984 .986 .986	***Incit to 1.51	7 ratio 0.67 0.936 .933 .924 .911 .905 .908 .907 .928 .939 .939 .934 .935 .94 .937 .938 .967 .967 .967	0.82 0.946 .945 .923 .923 .924 .913 .914 .925 .940 .925 .940 .926 .926 .936 .936 .936 .936 .936	\$\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	0.88t .877 .860 .860 .857 .863 .873 .896 .972 .965 .978 .965 .978 .961 .984	0. ht 0.905 .905 .856 .885 .877 .876 .886 .901 .939 .939 .939 .957 .972 .978 .984 .986	0.51 0.916 915 .995 .895 .886 .886 .891 .931 .939 .939 .939 .939 .939 .938 .938 .938	ty ret; 0.6e 0.927 .936 .915 .907 .904 .893 .897 .907 .928 .940 .940 .968 .971 .971 .971 .964 .963 .963	0.88 0.942 936 931 901 906 908 908 94 94 94 94 95 96 97 98 98 98 98 98 98 98 98 98 98	0.96 0.944 .932 .922 .910 .910 .910 .935 .948 .957 .957 .957 .958 .966 .986	

# TABLE I.- LOCAL VELOCITY RATIO, U/V - Continued

# (b) Modified conical spinner with cowl

Redial	X = 0.20					M = 0.No					M = 0.50							
station,	Inlet velocity ratio, V1/V					Inlet velocity ratio, V1/V					Inlet velocity ratio, V1/V							
in.	0.48	0.55	0,65	0.84	1.02	1.36	0.43	0-53	0.63	98.0	0.96	1.35	0.42	0.53	0.63	0.83	1.04	1.3
3.34	0.881	0.897	0.912	0.927	0.937	0.954	0.871	6.900	0.905	0.920	0.928	0.945	0.866	0.897	0.903	0.920	0.926	0.9
3.29	.885	-901	.911	.926	.941	956	870	.899	924	.919	.929	, juli	.863	-896	.904	.917	-929	.9
3. <b>2</b> 9 3.84	.885	.901	-911	.926	.936	956	.870	.896	.922	.917	926	.910	.861	-898 -888	.900	.915	-925	.9
4.09	.880	.896	.906	.916	.931	.916	868	.894	899	.909	.919	.932	859	-888	694	.907	-917	1 .9
4.84	.884	.900	-910	.915	.930	945	-875	.896	·30/	-914	.919	.932	.863	890	.898	.911	-915	.9
4.84	.884-	.895	910	.915	.925	-940	.877	.893	.900	.908	.915	925	.868	-866	.896	.907	-913	.9
5.34 5.84	.898	-909	.919	.929	.934	939	.890	.903	.905	.916	.920	.928	.869	-896	.902	.911	-917	.9
5.84	.908	.913	-923	-933	.938	943	.905	.910	.912	.921	.925	.933	.894	.907	.923	.913	-993	9.
6.34	.918	.913	923	-933	938 917	.949	906	.916	.918	.922	.928	936	.898	909	.913	.915	-923	.9
7.34	.932	-937	-947	.947		957	998	.930	-930	-935	937	.940	•900	-926	996	-934	-936	- 5
8.34	946	922	956	.956	•961	.961	.949	949	وباو	956	97	-971	940	.945	947	950	-949	.9
9.34	966	.954	-971	.971	.977.	.976	964	.962	960	.965	964	967	957	-959	961	-959	961	-9
10.34	.975	.975	-980	.900	.900	-985	.967	967	.981	.968	967	.967	.963	.965	.965	-963	-965	ۇ. ا
12.3k	984	984	-989	.989	.989	.989	-9(5	973	-973	.985	-975	-975	915	-973	973	.982	-973	.9
14.34	.987	.982	987	.987	987	987	.987	.984	984	.984	984	964	985	.985	.985	.978	984	1 .5
16.34	.991	-986	-991	.991	-991	.991	.903	.981	901	981	981	.981	.983	,983	963	985	-963	۱۰۶
18.34	.990	•990	-995	995	-995	-990	.983	.983	-983	-983	986	.983	.986	-986	.966	986	986	.5
20.34	-995	-995	1.000	995	995	1.000	998	.982	992	989	-992	.999	.994	.990	.990	.986	-992	- 5
22.34	.989	-969	99	-994	.994	.994	994	.961	991	.988	-991	.990	.969	.991	-991	-997	969	٠,5
24.34	.999	-999	1.004	1.004	1.004	1.004	.998	.990	-996	.996	993	•993	.996	.996	.996	.998	994	( .5
26.34	-993	.988	-993	-993	.998	998	-997	.969	995	-997	995	-995	.996	-996	.996	-996	-994	-5
28.34	-993	1.003	1.003	1.003	1.003	1.003	.996	.980	994	-99	1994	.994	995	-995	-995	-997	-995	1 .5
30.34	.998	1.000	1.003	1.003	1.008	1.003	-993	-993	990	.990	-993	•993	991	.991	-993	-991	-993	.9
32.34	-997	1.002	1.007	1.007	1.002	1.007	-997	989	.994	*994	997	-997	-998	1.000	1.000	1.000	1.000	.5
Redial	<b>и</b> = 0.60					K = 0.70					И = 0.80							
stabion,		Inlet	velocit	y ratio	, V <sub>1</sub> /V			Inlet	velocit	y ratio	, V <sub>1</sub> /V		Inlet valocity ratio, V1/V					
in,	0.34	0.43	0.54	0.65	0.85	1.05	0.32	0.42	0.50	0,62	0.82	1.11	0.30	0.41	0.52	0.62	0.82	0.9
3.34	0.867	0.885	0.893	0.898	0.912	0.917	0.856	0.880	0.863	0.891	0.907	0.916	0.838	0.865	0.874	0.884	0.894	0.9
	.872	.888	.901	.902	-90.6	920	.856	.882	885	.895	.907	-919	.841	.867	.875	.884	,897	.8
3.59	.867		.898	.898	.907	917	.853 .847	877	.880	.886	.901	.933	.837	.861	.870	.880	.890	1 .8
		.683					OLG !	.B70	.873	.882	.893	.904	.830	.855	.663	Geres .	dia.	1 .
		.878	.886			.910	•04/									.872	.682	3.
4.09	.867	.878		.891	.900	.910 .912	.851		.880	.885			.836	857	.866	874	.883	3,
4.09 4.34		.878	.886	.891 .895	.900 .902	912	.851 .853	.873 .870	.880 .876	.885	.896 .890	.907			.866 .860	879	.883	
4.09 4.34 4.84	.867 .867	.878	.886. 888.	.891 .895 .893	.900 .902 .900	-912 -907	.851	.073	.880	.885	.896	.907	.836	-857	.866	.874 .872 .875	.883 .862 .883	. E
4.09 4.34 4.84 3.94	.867 .867 .868 .880	.878 .879 .879	.886 .888 .886 .893	.891 .893 .893 .896	.900 .902 .900	.912 .907 .909	.851 .853 .863 .878	.873 .870	.880 .876	.885 .883	.896 .890 .896	.907	.836 .834 .844	.857 .855 .862 .870	.866 .862 .867	.872 .872 .875	.883 .882 .883	1.5
4.09 4.34 4.84 5.34 5.84	.867 .867 .868 .880 .893	.878 .879 .879 .886	.886 .888 .886 .893	.891 .895 .893 .896 .905	.900 .902 .900 .902	.912 .907 .909 .917	.851 .853	.873 .870 .880	.880 .876 .883	.885	.896 .890 .896	.907 .899	.836 .834 .844	.857 .855 .862 .870	.866 .869 .867 .875	.874 .872 .875 .883	.883 .862 .883	1.5
4.09 4.34 4.84 5.34 5.84 6.34	.867 .867 .868 .880 .893 .898	879 879 886 887 886	.886 .888 .886 .893 .900	.891 .893 .893 .896	.900 .902 .900	.912 .907 .909 .917	.851 .853 .863 .878	.873 .870 .880 .889	.880 .876 .883 .891	.885 .883 .888	.896 .890 .896	.907 .899 .904 .910 .910	.836 .834 .844	.857 .855 .862 .870	.866 .869 .867 .875 .879 .896	.879 .879 .875 .889 .884	.883 .882 .883 .890 .891	
4.09 4.34 4.84 5.84 5.84 6.34 7.34	.867 .868 .880 .893 .898	878 879 886 887 886 887	.886 .888 .886 .893 .900	.891 .893 .893 .896 .905 .909	.900 .902 .900 .902 .910 .914 .928	.912 .907 .909	.853 .863 .863 .878	.873 .870 .880 .889	.880 .876 .883 .891 .912 .933	.885 .888 .895 .897 .913	.896 .890 .896 .904	.907 .899 .904 .910 .910	.836 .834 .844 .857 .862	.857 .855 .862 .870 .874 .891	.866 .862 .867 .875 .879 .896 .918	.874 .872 .875 .883 .884 .900	.883 .882 .883 .890 .891 .903	
4.09 4.34 5.34 5.34 7.34 7.34	.867 .869 .890 .893 .896 .919	879 879 886 886 887 887 887 887 887 887 887 887	.886 .886 .893 .901 .903 .921	.891 .893 .896 .905 .909 .921	900 902 900 908 910 914	.912 .907 .909 .917 .926 .943	.853 .853 .863 .864 .866 .966	.873 .870 .880 .889 .892 .909	.880 .876 .883 .091 .894	.883 .888 .895 .897 .913 .933 .948	.896 .896 .904 .904 .919 .935	.907 .999 .904 .910 .910 .922 .938	.836 .834 .844 .857 .862 .886	.857 .859 .862 .870 .874 .894 .916	.865 .862 .867 .875 .879 .896 .918	.874 .872 .875 .883 .884 .900 .993	.883 .862 .883 .890 .891 .903 .924	.8
4.09 4.34 4.84 5.84 5.84 6.34 7.34	.867 .869 .890 .893 .939 .939	879 879 879 886 887 887 897 897 897 897 897 897 897 897	.886 .886 .893 .901 .903 .921 .948	.891 .893 .896 .905 .909 .921 .941	900 900 900 910 914 988 943	.912 .907 .909 .917 .928 .943	.853 .863 .878 .883 .986	.873 .870 .880 .889 .892 .909	.880 .876 .883 .891 .912 .933	.885 .888 .895 .897 .913 .918 .948	.896 .896 .904 .904 .919 .935 .920	.907 .899 .904 .910 .910	836 834 844 897 862 886 910	.857 .852 .870 .874 .894 .916 .934	.866 .869 .867 .875 .879 .896 .918 .935	.874 .872 .875 .883 .884 .900 .993 .937	.883 .883 .890 .891 .903 .924 .910	.8 .8 .8 .9 .9
4.09 4.34 4.84 5.84 5.84 7.34 7.34 9.34	.867 .869 .890 .893 .896 .919	879 879 886 886 887 887 887 887 887 887 887 887	.886 .886 .893 .901 .903 .921 .924 .979 .979	.891 .893 .896 .905 .909 .921	.900 .900 .900 .914 .928 .943	.912 .907 .909 .917 .926 .943	\$5.50 \$5.50	.873 .870 .880 .889 .892 .909 .933	.880 .876 .883 .091 .894 .912 .933	.885 .888 .895 .897 .913 .948 .948	.896 .896 .904 .904 .919 .935 .944 .969	907 904 910 910 982 938 946 938	.836 .834 .807 .862 .886 .910 .931	.857 .852 .870 .874 .894 .916 .934	.865 .862 .867 .875 .879 .896 .918 .935 .918	.874 .879 .889 .884 .900 .993 .910 .925	.883 .883 .890 .893 .924 .940 .922	
4.09 4.34 4.84 5.84 7.84 7.84 9.34 10.34	.867 .867 .868 .880 .893 .898 .939 .937 .960	\$55.55 \$5	.886 .888 .886 .893 .901 .903 .921 .948 .975 .979 .970	.891 .893 .896 .905 .909 .921 .941 .975 .979 .979	.900 .902 .900 .910 .914 .928 .943 .959	.912 .907 .909 .917 .926 .943 .959	55. 553. 553. 553. 554. 554. 554. 554. 5	.873 .870 .880 .889 .999 .933 .946 .940 .964	.880 .876 .883 .091 .994 .912 .916	.885 .888 .895 .897 .913 .918 .948	.896 .896 .904 .904 .919 .935 .944 .969	.907 .899 .904 .910 .910 .922 .938 .946 .938 .965	.836 .834 .857 .869 .886 .910 .915 .951	.857 .859 .870 .874 .894 .916 .934 .938 .938	.866 .867 .875 .879 .896 .918 .935 .918	.874 .872 .875 .883 .900 .903 .917 .910	.883 .883 .890 .891 .903 .924 .910 .922 .942	
4.09 4.34 4.84 5.84 5.84 7.84 9.034 14.34	.867 .869 .880 .898 .898 .937 .957 .967	.878 .879 .879 .886 .897 .936 .937 .936 .954	.886 .888 .886 .893 .901 .903 .921 .948 .975 .979 .970	.891 .893 .896 .905 .909 .921 .941 .975 .979 .979	.900 .902 .900 .908 .914 .988 .943 .959 .979 .979	917 927 927 927 927 928 943 959 959	55. 553. 553. 553. 554. 554. 554. 554. 5	.873 .870 .880 .889 .999 .933 .946 .940 .964	.880 .876 .883 .091 .918 .933 .946 .946 .976	.885 .883 .886 .895 .897 .913 .918 .918 .964 .976	.896 .896 .994 .919 .935 .935 .944 .969 .976	.907 .899 .904 .910 .910 .922 .938 .946 .938 .965	.836 .834 .844 .857 .862 .910 .911	.857 .859 .870 .874 .916 .934 .938 .938 .954	.866 .862 .867 .875 .879 .896 .918 .935 .918 .955	.874 .872 .875 .883 .900 .903 .910 .910 .957 .913	.883 .883 .890 .891 .903 .924 .940 .922 .942	
4.09 4.34 4.84 5.84 5.84 7.84 9.034 14.34 14.34	.867 .869 .880 .893 .898 .939 .957 .960 .954	.878 .879 .879 .886 .897 .936 .937 .936 .954	.886 .888 .893 .900 .903 .948 .979 .960	.891 .895 .893 .896 .905 .909 .921 .955 .979 .979 .983	.900 .902 .900 .908 .914 .928 .943 .955 .979	.912 .907 .909 .917 .928 .943 .959 .979 .979	\$5555555555555555555555555555555555555	.873 .870 .880 .889 .999 .933 .946 .964 .976 .979	.880 .876 .883 .091 .918 .933 .916 .916 .966	.885 .883 .897 .897 .913 .948 .949 .964	.896 .896 .904 .904 .919 .935 .976 .976 .976	.907 .899 .910 .910 .910 .910 .910 .910 .910 .9	.836 .834 .857 .869 .886 .910 .915 .951	.857 .859 .862 .870 .874 .934 .934 .934 .934 .954	.866 .862 .867 .875 .879 .896 .918 .935 .918 .954	.874 .872 .883 .884 .900 .963 .910 .957 .910	.883 .862 .883 .890 .891 .903 .924 .910 .922 .942 .967 .976	.8.6.6.6.6.6.6.6.6.6.6.6.6.6.6.6.6.6.6.
4.09 4.34 5.84 5.83 7.83 9.34 10.34 116.34	36.50 36.50	\$5.585555555555555555555555555555555555	.886 .888 .893 .900 .903 .948 .979 .960	.891 .893 .896 .905 .909 .921 .941 .955 .979	.900 .902 .900 .908 .914 .988 .943 .959 .979 .979	.912 .907 .909 .917 .928 .943 .959 .979 .979	£5555555555555555555555555555555555555	.873 .870 .880 .889 .999 .933 .946 .940 .964	.880 .876 .883 .091 .918 .933 .946 .946 .976	.885 .888 .895 .897 .933 .948 .954 .976 .978 .988	.866 .890 .894 .904 .935 .956 .957 .957 .957 .958 .968	.907 .904 .910 .910 .918 .946 .938 .946 .936 .976 .976 .976 .976	.836 .834 .857 .862 .866 .915 .955 .955 .955	.877 .856 .870 .874 .934 .934 .934 .954 .954 .954	.866 .862 .867 .875 .879 .896 .918 .935 .914 .965 .974	.875 .889 .883 .900 .937 .937 .937 .937 .937 .937 .937 .937	.883 .852 .893 .890 .894 .940 .942 .942 .967 .976	.8.6.6.6.6.6.6.6.6.6.6.6.6.6.6.6.6.6.6.
4.09 4.84 5.84 5.84 7.83 10.34 11.33 11.33 11.34 11.34 11.34 11.34 11.34	867 888 889 99 95 66 688 888 899 95 56 688 888 899 95 56 688 888 899 95 56 688 898 898 898 898 898 898 898 898	.878 .879 .879 .886 .897 .936 .937 .936 .954	.886 .888 .893 .904 .903 .921 .948 .979 .960 .977	.891 .895 .893 .896 .905 .909 .921 .955 .979 .979 .983	\$6.50 \$6.50	.912 .907 .909 .917 .928 .943 .955 .959 .979	55. 553. 553. 553. 554. 554. 554. 554. 5	.873 .870 .880 .889 .999 .933 .946 .964 .976 .979	.880 .876 .883 .091 .918 .916 .916 .916 .976 .976	.883 .888 .895 .897 .933 .948 .954 .976 .978 .989 .987	866 896 904 904 909 970 970 970 970 970 970 970 970 970	.907 .904 .910 .910 .946 .938 .946 .936 .976 .976 .988 .989	.836 .834 .834 .856 .886 .931 .915 .951 .951 .966 .971 .967	857 858 850 854 855 858 858 858 858 858 858 858 858	866 867 875 875 875 875 875 875 875 875 875 87	. Bri	.883 .863 .890 .993 .910 .922 .940 .942 .947 .948 .948	
4.09 4.34 4.38 4.38 4.33 4.33 112.34 116.33 116.33 116.33 116.33 116.33	867 888 889 957 957 958 959 951 959 951 959 951	\$\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	.886 .886 .893 .904 .903 .904 .905 .905 .905 .905 .905 .905 .905 .905	.891 .893 .896 .909 .909 .914 .955 .959 .979 .979 .989	.502 .502 .504 .504 .505 .505 .505 .505 .505 .505	.917 .927 .927 .927 .925 .925 .925 .925 .925 .925 .925 .925	££££888833855£885	.813 .810 .889 .892 .903 .946 .946 .976 .976 .978 .988	.850 .876 .883 .891 .933 .936 .936 .976 .976 .979 .989	883 883 885 887 887 887 887 887 887 887 887 887	.856 .850 .854 .904 .905 .905 .905 .905 .905 .905 .905 .905	.907 .904 .910 .910 .918 .946 .938 .946 .936 .976 .976 .976 .976	.836 .834 .857 .886 .890 .915 .951 .955 .966 .975 .988 .987	.857 .859 .862 .870 .874 .934 .934 .934 .934 .954	866 867 875 899 899 899 895 895 895 895 895 895 89	84 86 937 977 977 977 978 989	.883 .883 .893 .993 .94 .94 .967 .964 .966 .966 .966 .969	
4.09 34 4.58 4.58 4.38 4.38 4.38 4.38 4.38 4.38 4.38 4.3	85788 8 8 8 9 9 9 5 9 5 9 8 8 8 8 9 9 9 9 9	######################################	.886 .888 .886 .993 .924 .979 .960 .979 .963 .989 .999	.891 .897 .893 .896 .909 .921 .944 .975 .979 .979 .979 .983 .989	88888888888888888888888888888888888888	917 907 907 907 907 907 907 907 907 907 90	££\$£\$\$\$\$\$\$\$\$\$\$\$	.813 .810 .889 .889 .909 .933 .946 .940 .954 .979 .988 .989 .999	.860 .876 .883 .891 .936 .942 .946 .942 .956 .979 .989	883 883 885 887 887 887 887 887 887 887 887 887	.856 .850 .854 .904 .905 .905 .905 .905 .905 .905 .905 .905	.907 .904 .910 .910 .918 .916 .916 .916 .916 .916 .916 .916 .916	.836 .834 .857 .886 .890 .915 .951 .955 .966 .975 .988 .987	8775 886 874 874 875 875 875 875 875 875 875 875 875 875	888 887 875 886 887 888 887 888 887 888 887 888 887 888 888 887 888 88	.875 .884 .900 .937 .937 .937 .937 .937 .939 .939 .939	883 883 899 893 993 984 982 987 986 986 986 986 986	
4.4.5.56.78.93.4.4.4.3.3.3.4.4.4.3.4.4.3.4.4.3.4.4.3.4.4.3.4.4.4.3.4.4.4.3.4	\$5588\$	\$\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	.866 .886 .886 .903 .903 .924 .975 .960 .977 .963 .989 .994	.891 .895 .893 .893 .905 .909 .914 .909 .929 .939 .939 .939 .939	\$0.00 \$0.00	91 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	888888885885588888	.873 .870 .880 .892 .909 .933 .946 .910 .975 .988 .989 .998	.880 .876 .883 .894 .912 .916 .916 .916 .976 .979 .982 .999 .999	883 883 885 887 887 887 887 887 888 887 887 888 887 888 888 888 887 888 888 888 888 887 888 86 86	850 850 850 950 950 950 950 950 950 950 950 950 9	.907 .904 .910 .912 .913 .915 .915 .916 .916 .916 .916 .916 .916 .916 .916	.836 .834 .834 .836 .836 .935 .935 .955 .957 .967 .967 .967 .968	8775 886 874 874 875 875 875 875 875 875 875 875 875 875	888 887 875 886 887 888 887 888 887 888 887 888 887 888 888 887 888 88	.875 .884 .900 .937 .937 .937 .937 .937 .939 .939 .939	.883 .883 .893 .993 .94 .94 .967 .964 .966 .966 .966 .969	.86 .86 .86 .85 .85 .85 .85 .85 .85 .85 .85 .85 .85
4.09 34 4.58 4.58 4.38 4.38 4.38 4.38 4.38 4.38 4.38 4.3	85788 8 8 8 9 9 9 5 9 5 9 8 8 8 8 9 9 9 9 9	######################################	.886 .888 .886 .993 .924 .979 .960 .979 .963 .989 .999	.891 .897 .893 .896 .909 .921 .944 .975 .979 .979 .979 .983 .989	88888888888888888888888888888888888888	917 907 907 907 907 907 907 907 907 907 90	££\$£\$\$\$\$\$\$\$\$\$\$\$	.813 .810 .889 .889 .909 .933 .946 .940 .954 .979 .988 .989 .999	.860 .876 .883 .891 .936 .942 .946 .942 .956 .979 .989	883 883 885 887 887 887 887 887 887 887 887 887	.856 .850 .854 .904 .905 .905 .905 .905 .905 .905 .905 .905	.907 .904 .910 .910 .918 .916 .916 .916 .916 .916 .916 .916 .916	.836 .834 .857 .886 .890 .915 .951 .955 .966 .975 .988 .987	857 858 850 855 850 855 855 855 855 855 855	866 867 875 899 899 899 895 895 895 895 895 895 89	84 86 937 977 977 977 978 989	883 883 899 893 993 984 982 987 986 986 986 986 986	.88 .88 .88 .89 .99 .99 .99 .99 .99 .99

# TABLE I.- LOCAL VELOCITY RATIO, U/V - Concluded

# (c) The 1-series spinner, no cowl

Radial station, in.	M=0.15	M=0.20	M=0 • 40	M=0.50	M=0.60	<b>M</b> =0.70	M=0.80
3.44	1.071	1.079	1.088	1.092	1.102	1.108	1.124
3.69	1.070	1.078	1.082	1.095	1.102	1.109	1.124
3.94	1.063	1.068	1.077	1.079	1.089	1.094	1.107
4.19	1.049	1.063	1.062	1.067	1.076	1.081	1.092
4.44	1.042	1.057	1.059	1.063	1.071	1.076	1.088
4.94	1.021	1.037	1.043	1.046	1.059	1.064	1.071
5.44	1.020	1.030	1.035	1.038	1.050	1.052	1.065
5.94	1.019	1.029	1.028	1.036	1.044	1.046	1.055
6.44	1.013	1.019	1.020	1.024	1.031	1.034	1.043
7.44	1.005	1.018	1.014	1.014	1.023	1.027	1.032
8.44	•997	1.012	1.015	1.014	1.023	1.027	1.033
9.44	1.003	1.011	1.008	1.014	1.021	1.025	1.035
10.44	1.002	1.005	1.005	1.006	1.011	1.013	1.013
12.44	1.001	1.004	1.001	1.004	1.004	1.005	
14.44	•999	•997	1.005	1.003	1.006	1.007	1.004
16.44	•998	•996	-999	•997	1.002	1.003	1.001
18.44	•997	•995	•996	•996	1.002	1.002.	
20.44	•997	1.000	1.000	1.004	1.004	1.005	1.001
22.44	•899	•999	-997	1.001	1.001	1.002	1.000
24.44	1.003	1.009	1.001	1.004	1.002	1.003	•998
26.44	•995	1.003	1.000	1.002	1.005	1.003	997
28.44	1.002	1.008	1.001	1.001	1.004	1.005	•999
30.44	1.002	1.008	1.003	1.001	1.003	1.003	1.001
32.44	1.001	1.007	1.004	1.006	1.008	1.004	1.001

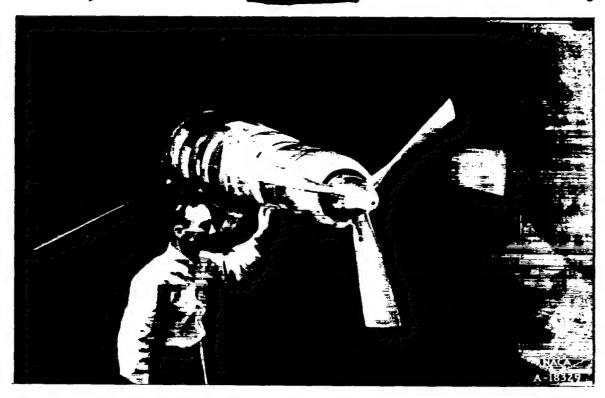


Figure 1.- The model mounted on the 1000-horsepower propeller dynamometer in the 12-foot pressure wind tunnel.

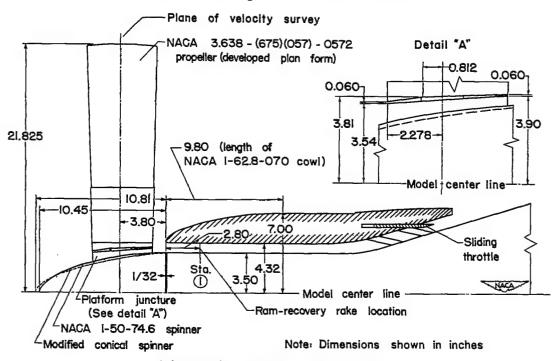


Figure 2.- Model arrangement.



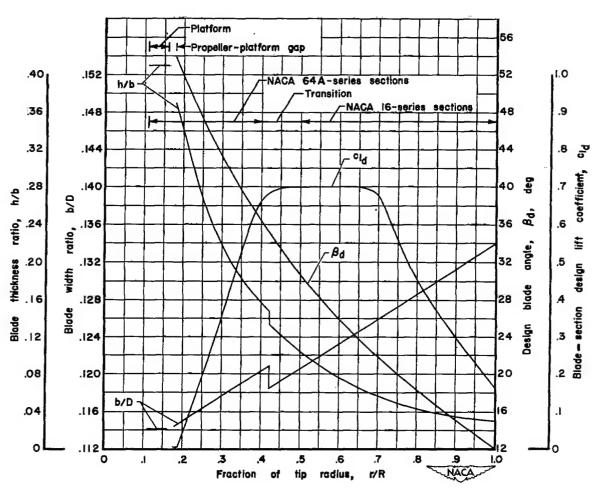


Figure 3.- Plan-form and blade-form curves for the model propeller having the designation NACA 3.638-(675)(057)-0572.

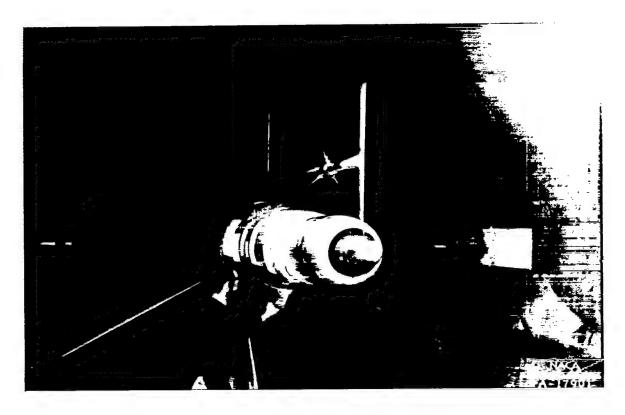


Figure 4.- Photograph of the survey rake.

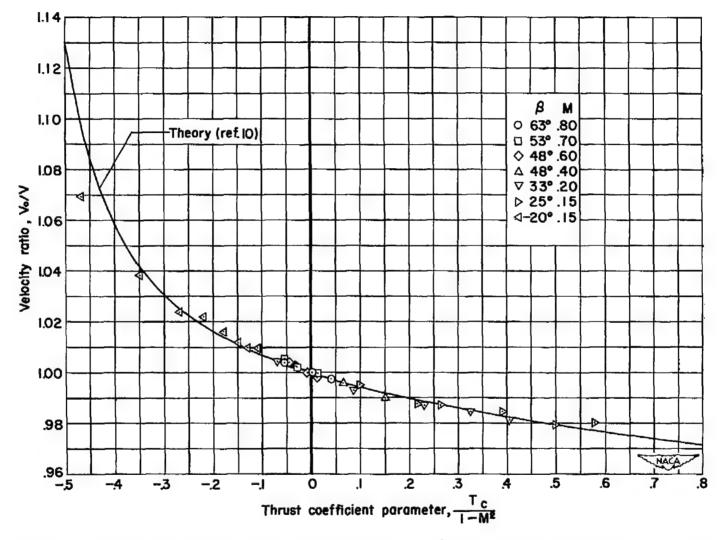


Figure 5.- Tunnel-wall-interference correction for a 3.6-foot-diameter propeller in the Ames 12-foot pressure wind tunnel.

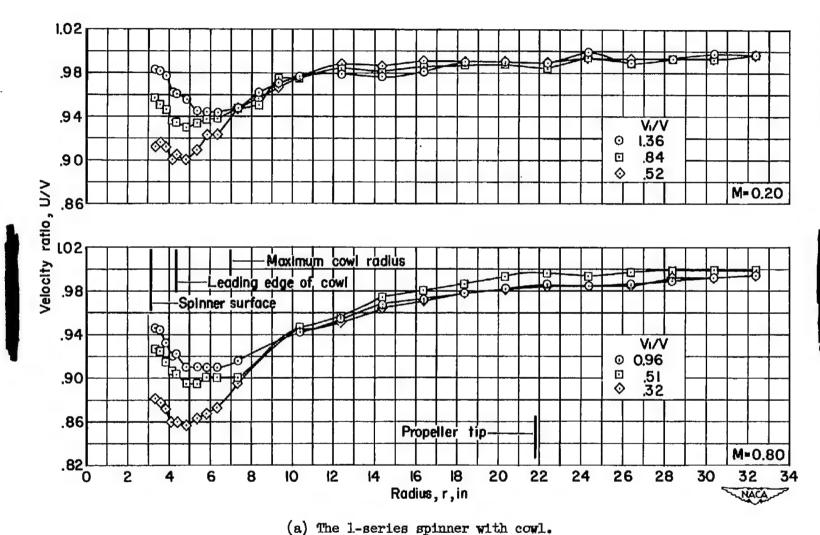
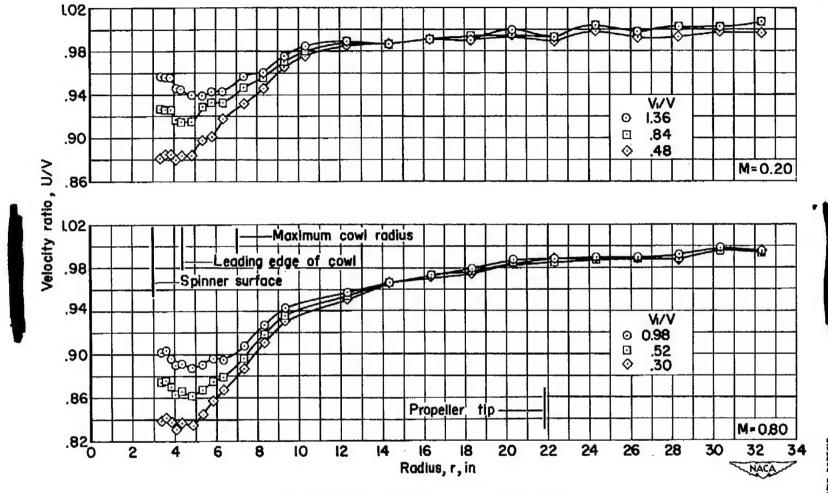
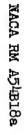


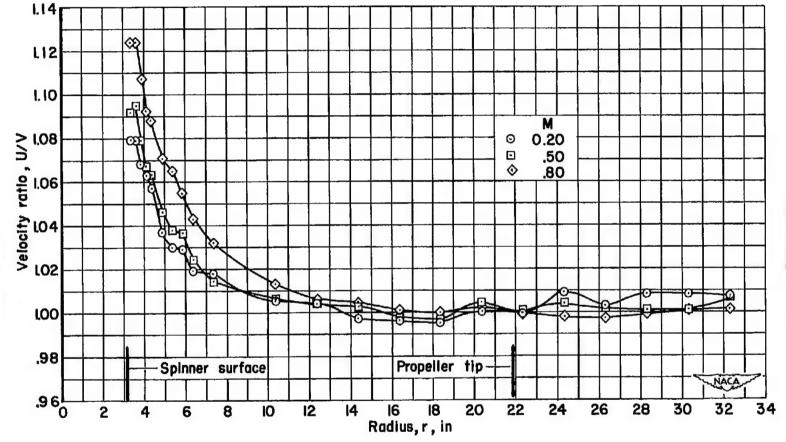
Figure 6.- Typical radial distributions of the local velocity ratio in the plane of the propeller.



(b) Modified conical spinner with cowl.

Figure 6.- Continued.





(c) The 1-series spinner, no cowl.

Figure 6.- Concluded.

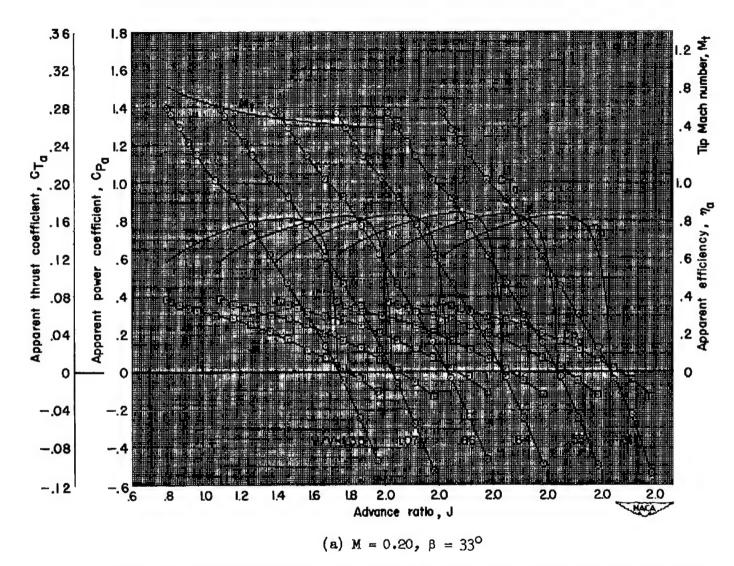
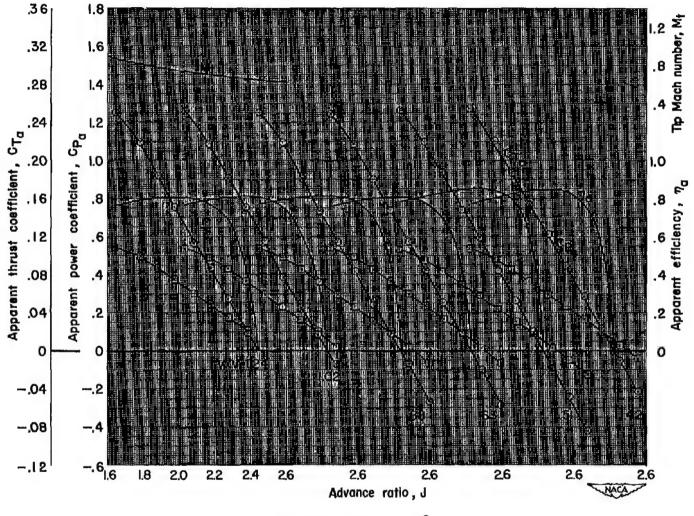
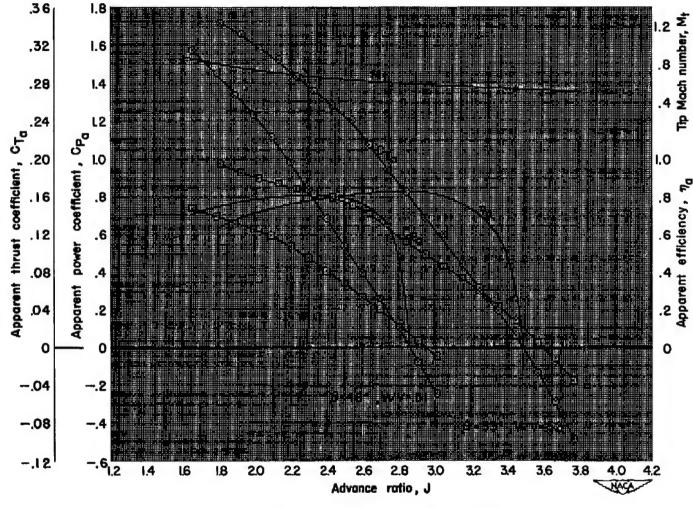


Figure 7.- Characteristics of the propeller with the 1-series spinner and cowl.



(b) M = 0.40,  $\beta = 43^{\circ}$ 

Figure 7.- Continued.



(c) M = 0.40,  $\beta = 48^{\circ}$  and  $53^{\circ}$ 

Figure 7.- Continued.

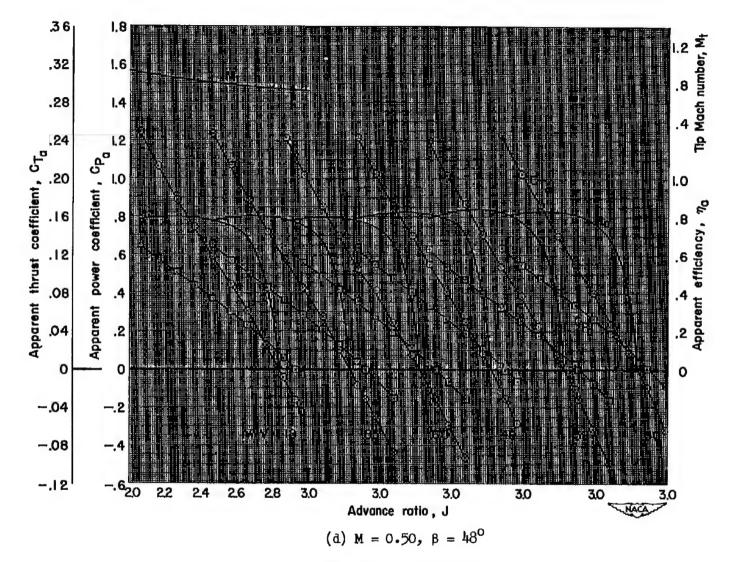


Figure 7.- Continued.

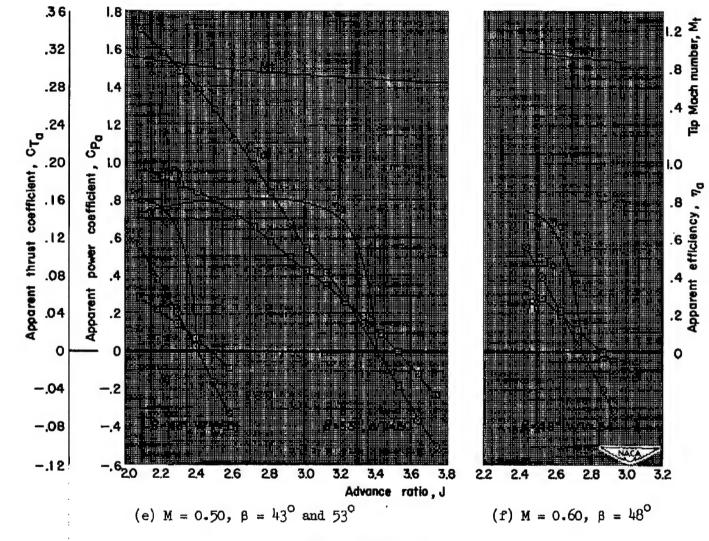
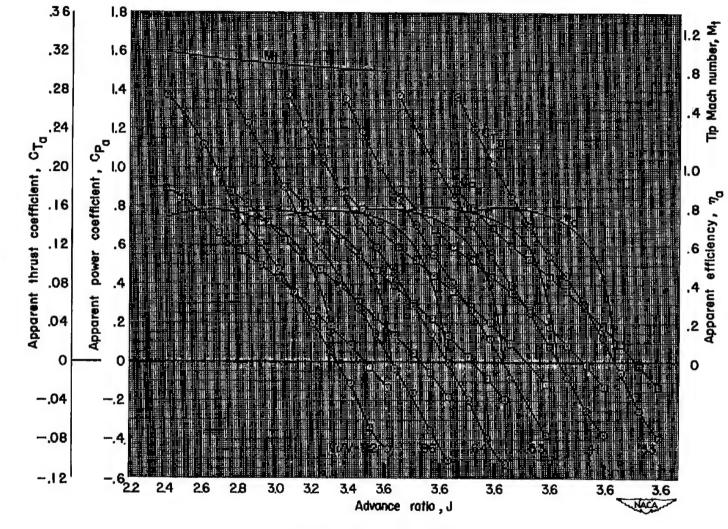
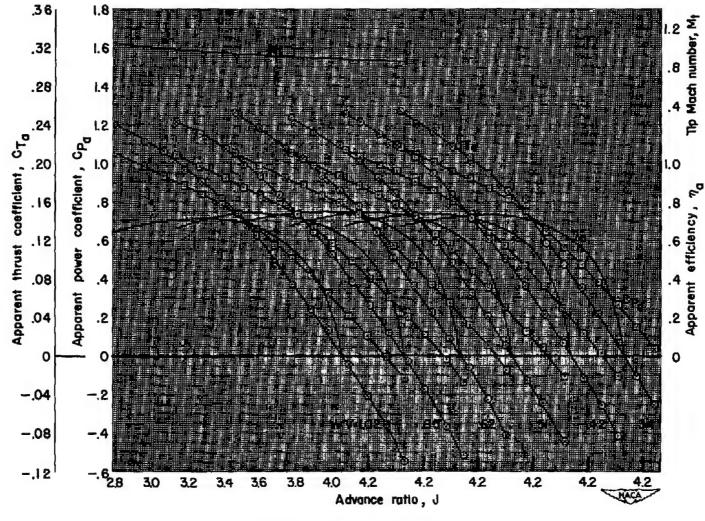


Figure 7.- Continued.



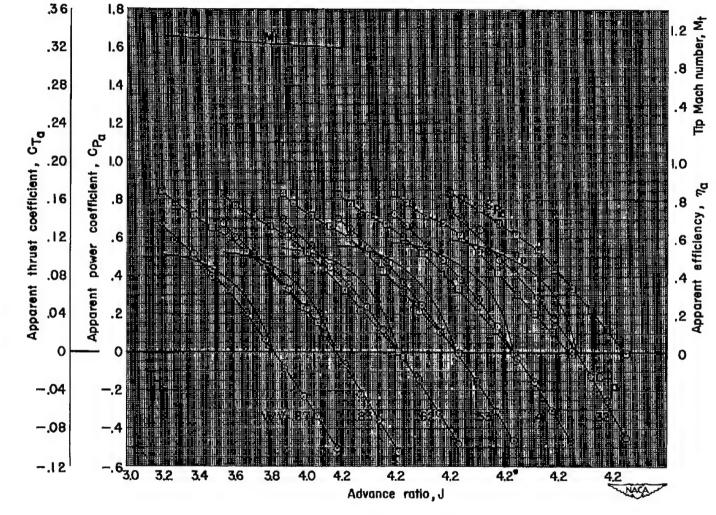
(g) M = 0.60,  $\beta = 53^{\circ}$ 

Figure 7.- Continued.



(h) M = 0.70,  $\beta = 58.5^{\circ}$ 

Figure 7.- Continued.



(i) M = 0.80,  $\beta = 58.5^{\circ}$ 

Figure 7.- Concluded.

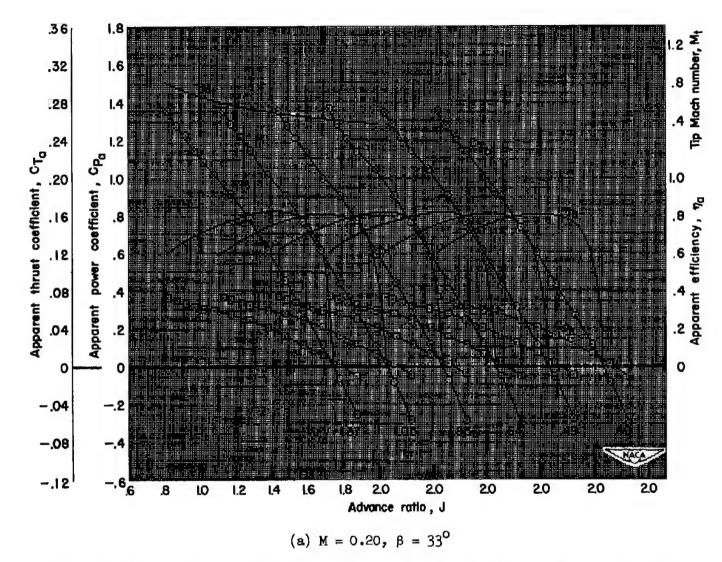


Figure 8.- Characteristics of the propeller with the modified conical spinner and cowl.

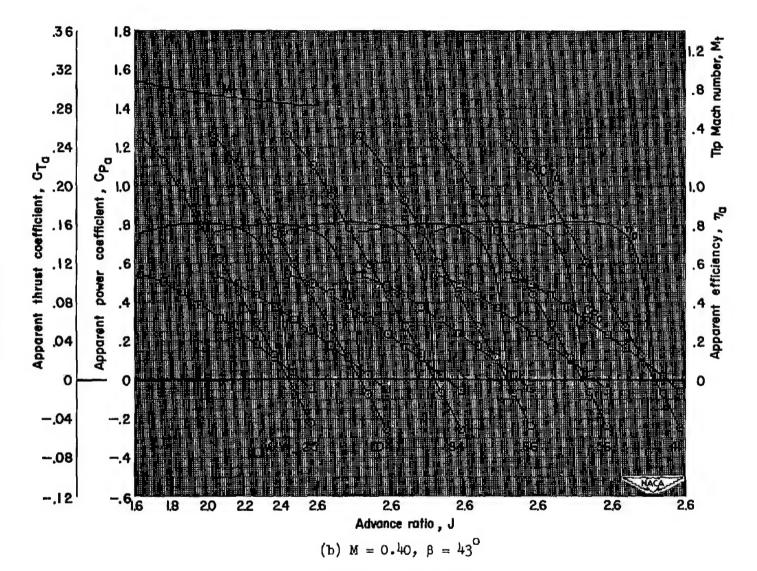
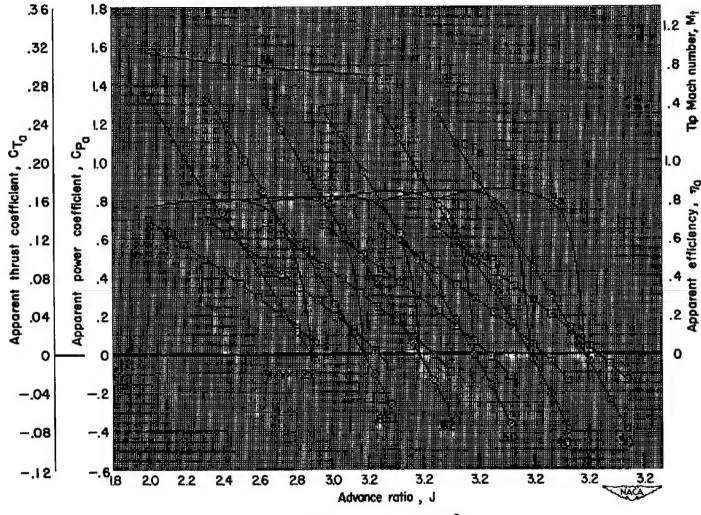
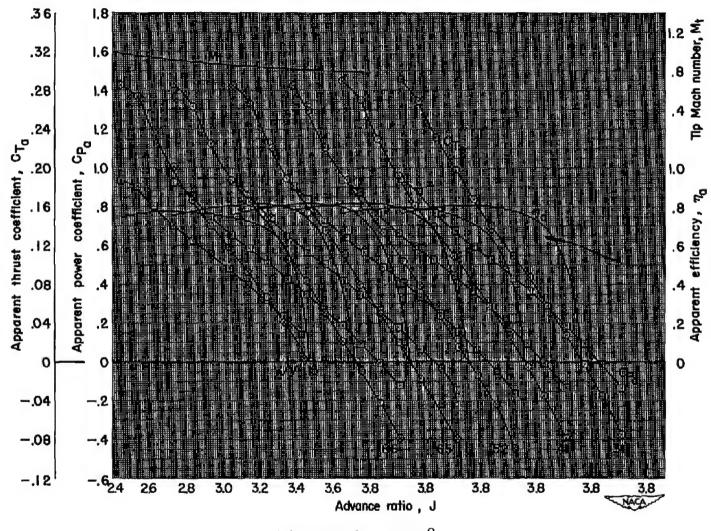


Figure 8.- Continued.



(c) M = 0.50,  $\beta = 48^{\circ}$ 

Figure 8.- Continued.



(d) M = 0.60,  $\beta = 53^{\circ}$ 

Figure 8.- Continued.

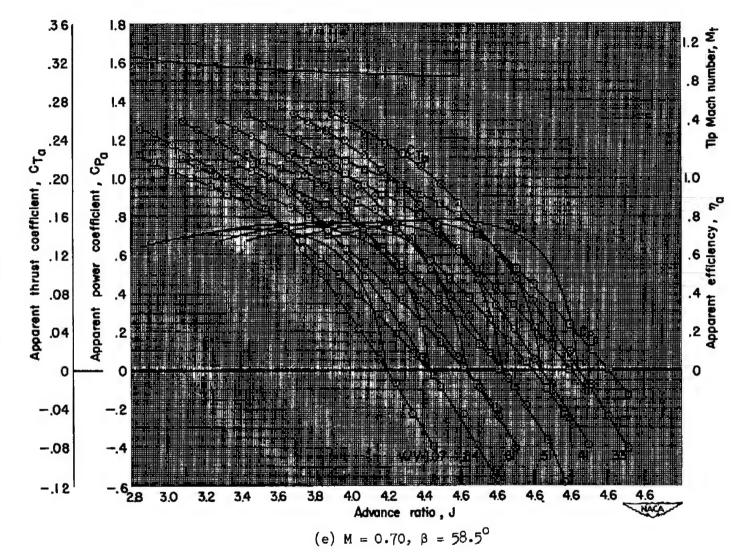
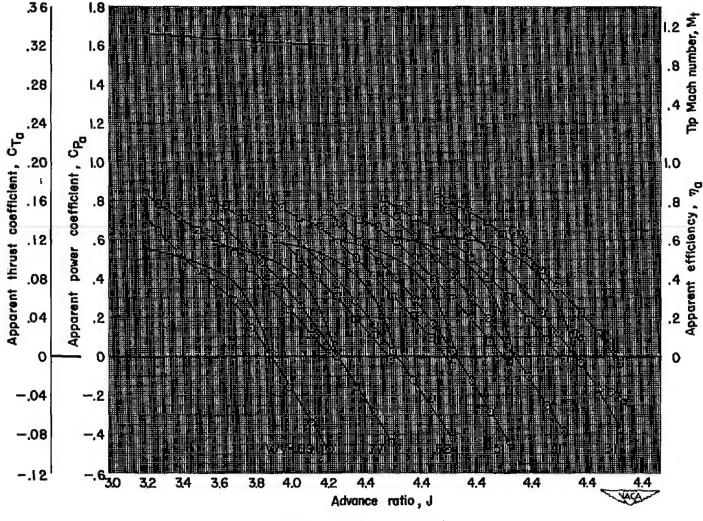


Figure 8.- Continued.



(f) M = 0.80,  $\beta = 58.5^{\circ}$ 

Figure 8.- Concluded.

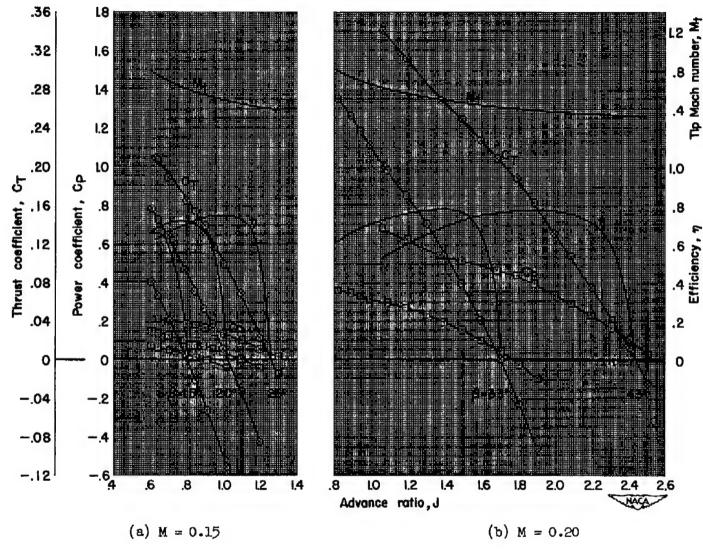
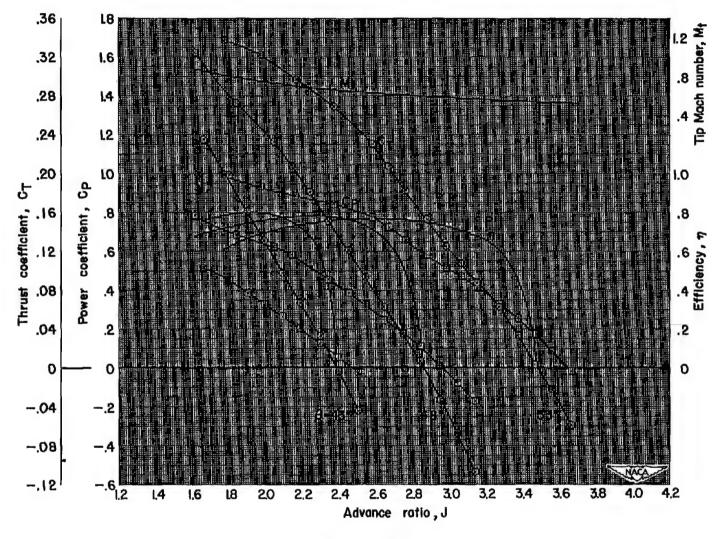
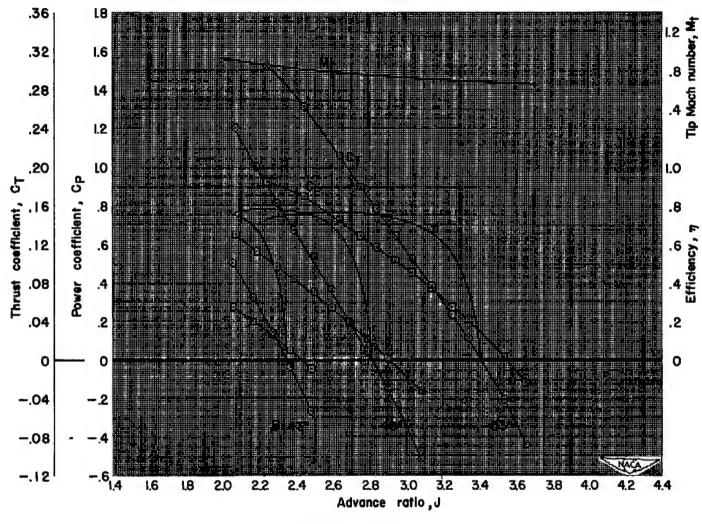


Figure 9.- Characteristics of the isolated propeller-spinner combination.



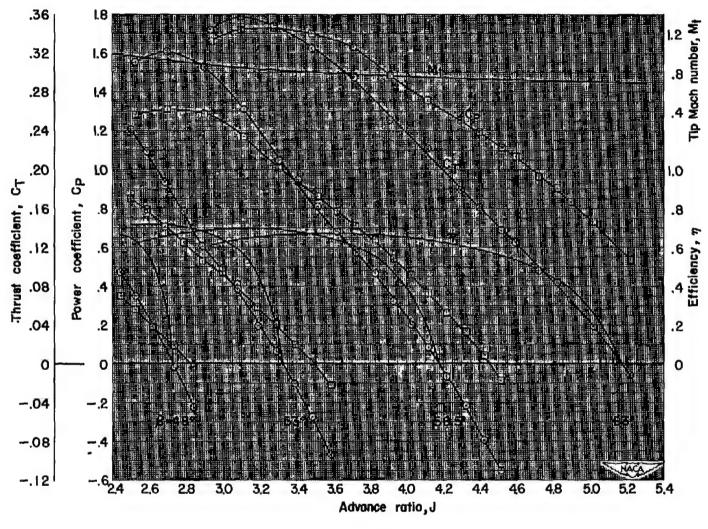
(c) M = 0.40

Figure 9.- Continued.



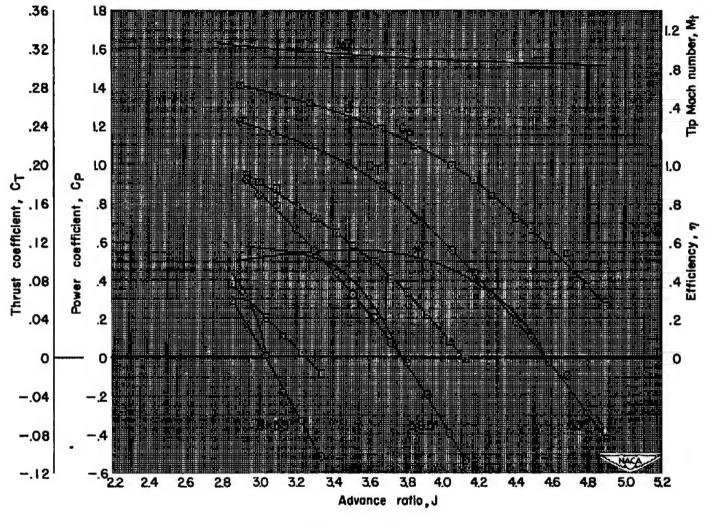
(d) M = 0.50

Figure 9.- Continued.



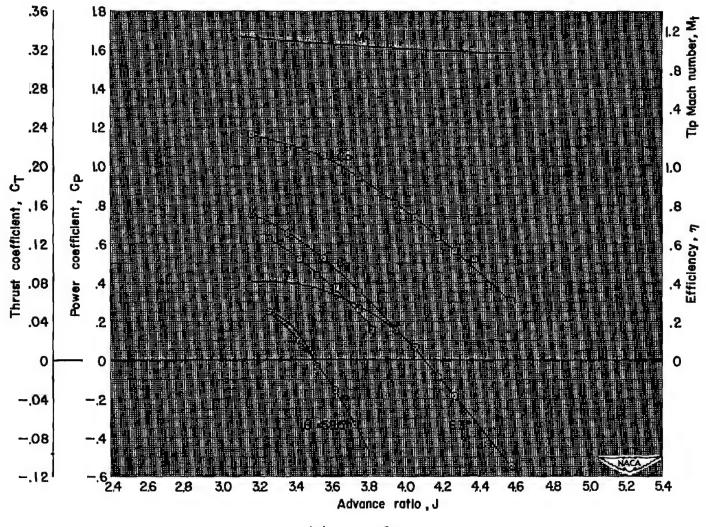
(e) M = 0.60

Figure 9.- Continued.



(f) M = 0.70

Figure 9.- Continued.



(g) M = 0.80

Figure 9 .- Concluded.

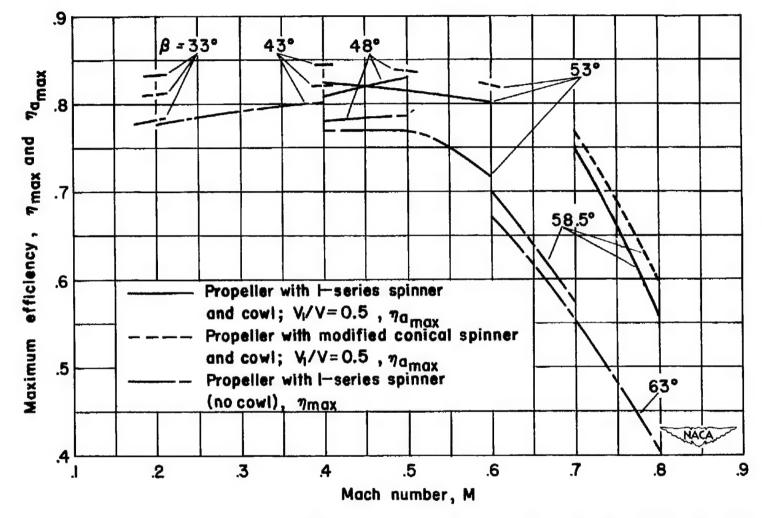


Figure 10.- Comparison of the maximum efficiency of the propeller with and without the cowl.

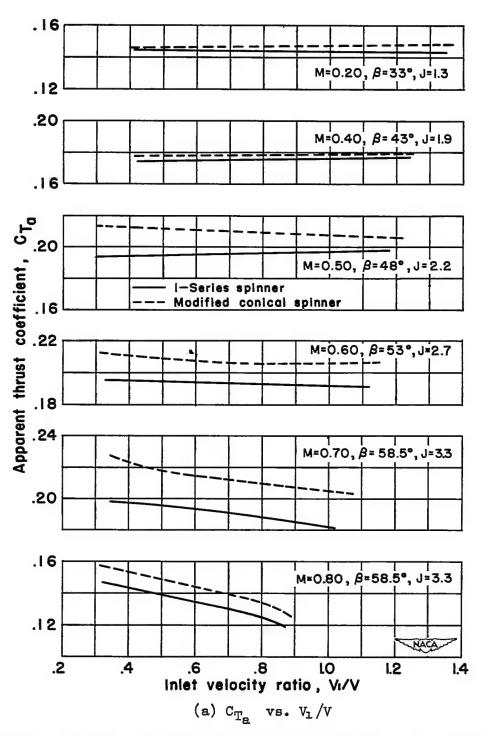


Figure 11.- Typical effect of inlet velocity ratio on the apparent thrust and power coefficients of the propeller.



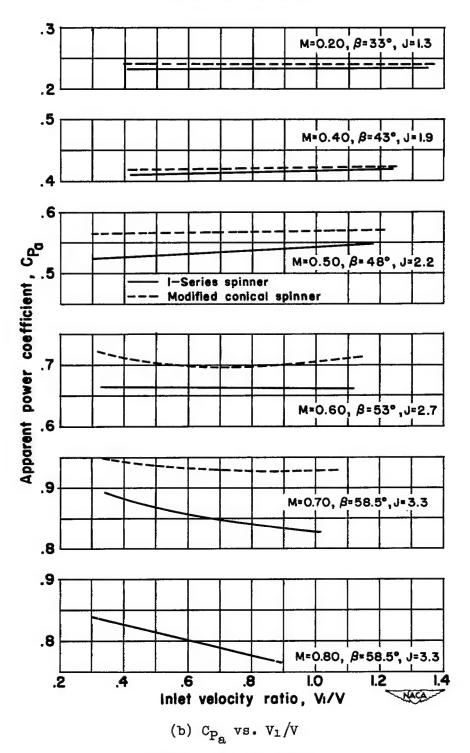


Figure 11.- Concluded.



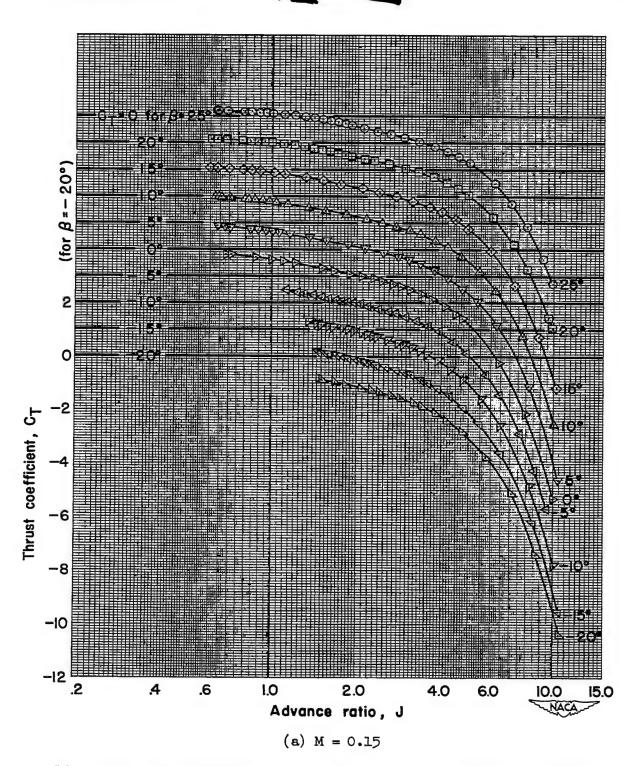
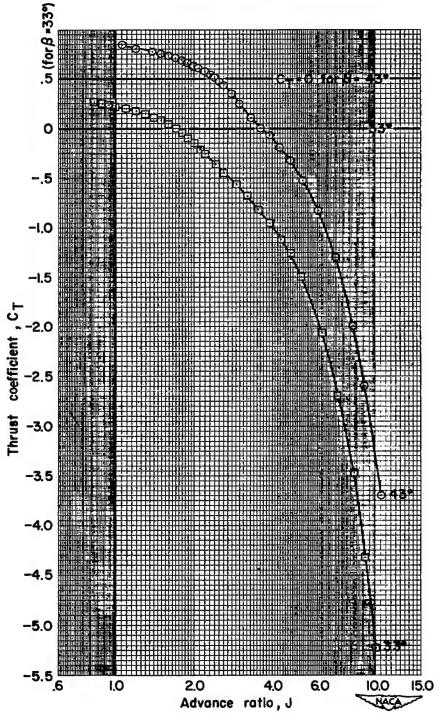


Figure 12.- Negative thrust coefficients for the isolated propellerspinner combination.







(b) M = 0.20

Figure 12.- Continued.





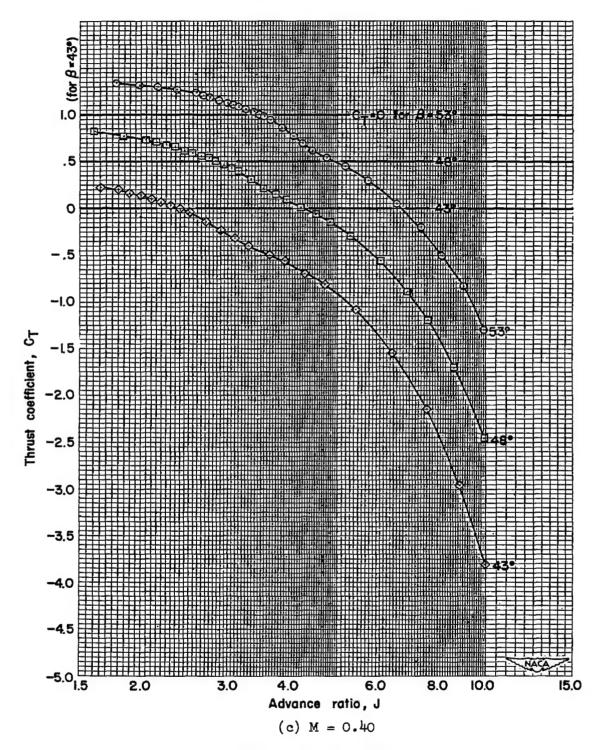


Figure 12.- Continued.



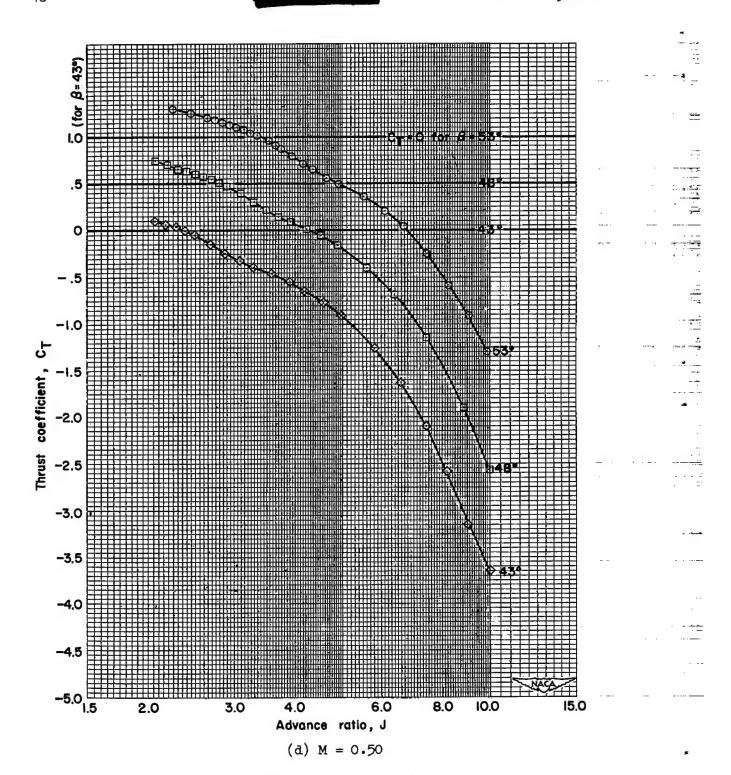
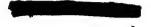
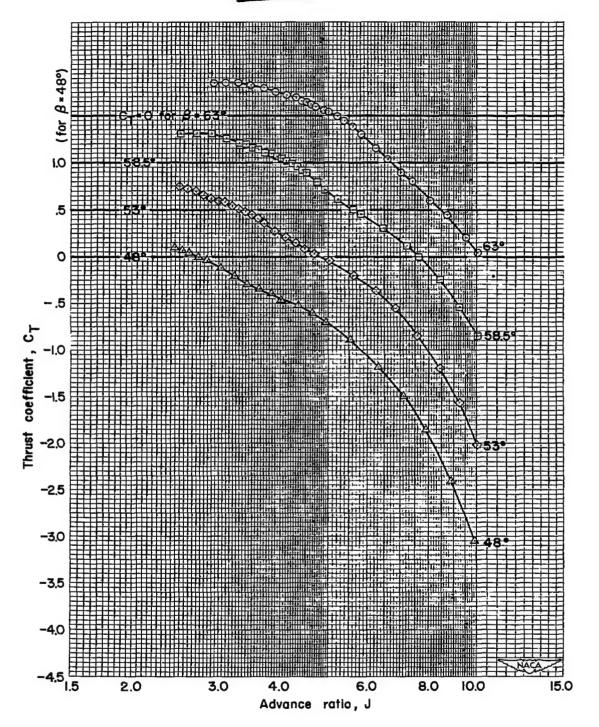


Figure 12.- Continued.



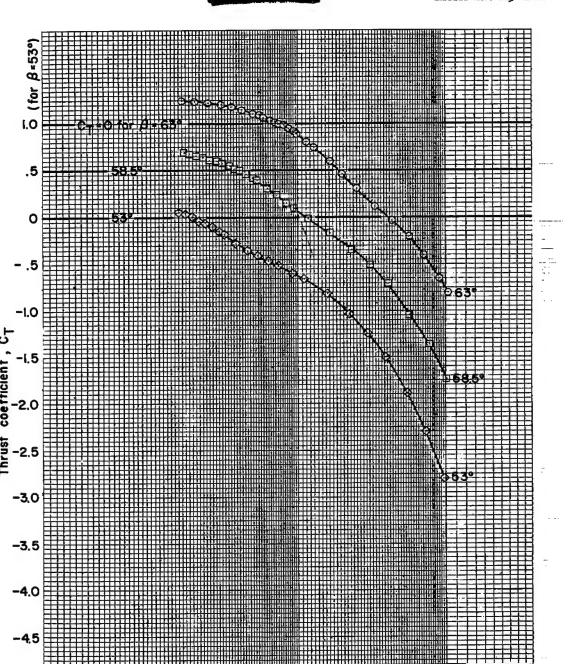




(e) M = 0.60

Figure 12.- Continued.





(f) M = 0.70

Advance ratio, J

4.0

3.0

2.0

8.0

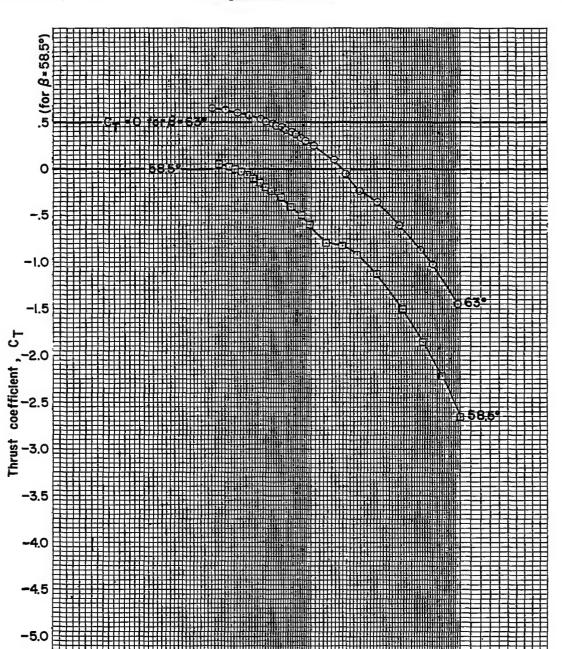
6.0

10.0

15.0

Figure 12.- Continued.





(g) 
$$M = 0.80$$

Advance ratio, J

8.0

10.0

15.0

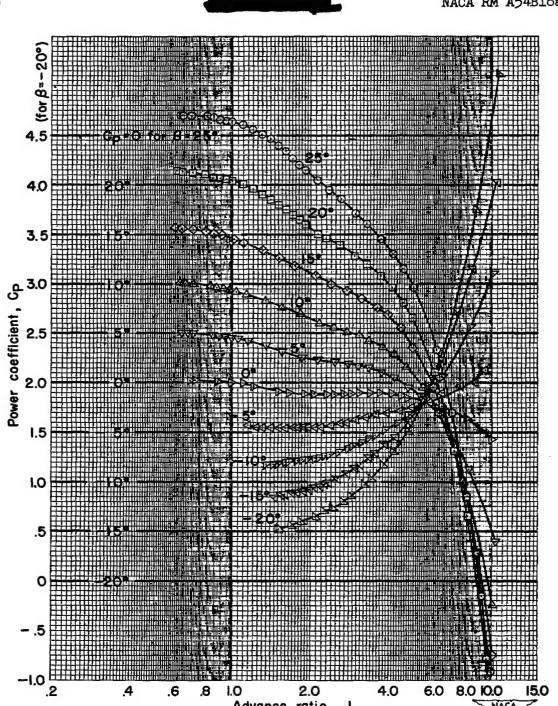
4.0

3.0

2.0

Figure 12.- Concluded.





(a) M = 0.15

Advance ratio, J

2.0

4.0

6.0 8.0 10.0

.6

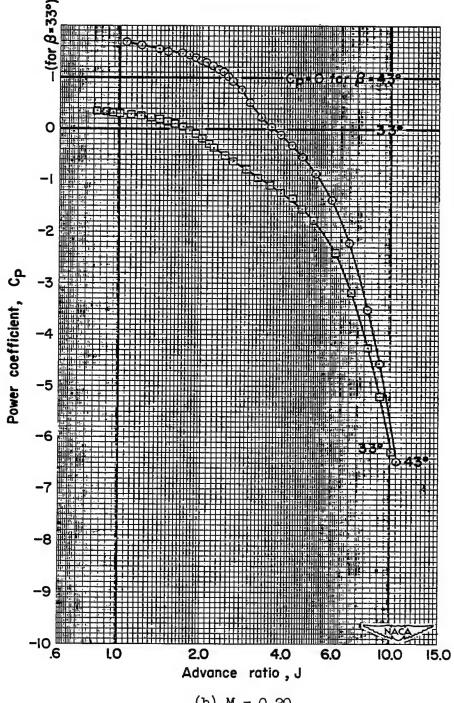
8.

1.0

Figure 13.- Power coefficients for the isolated propeller-spinner combination in negative thrust.



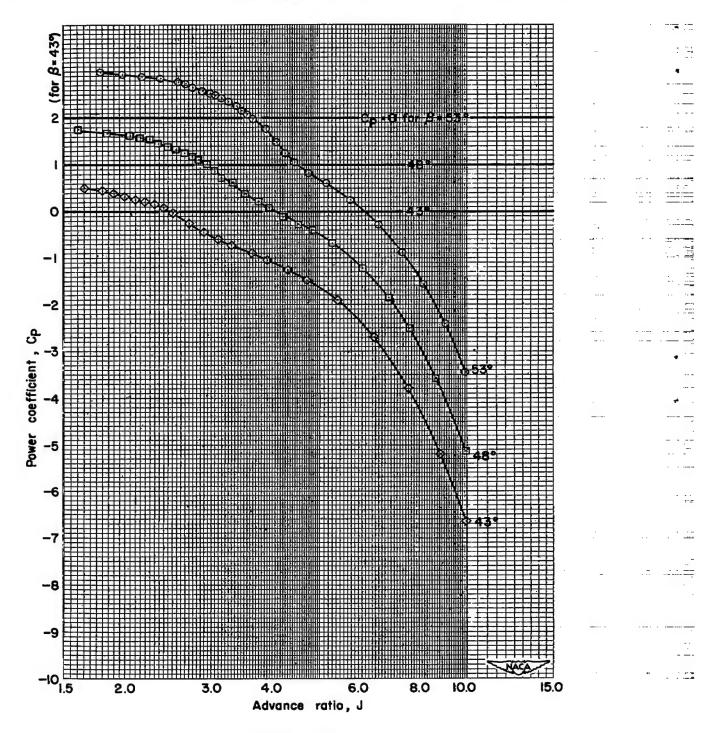




(b) M = 0.20

Figure 13.- Continued.





(c) M = 0.40

Figure 13.- Continued.





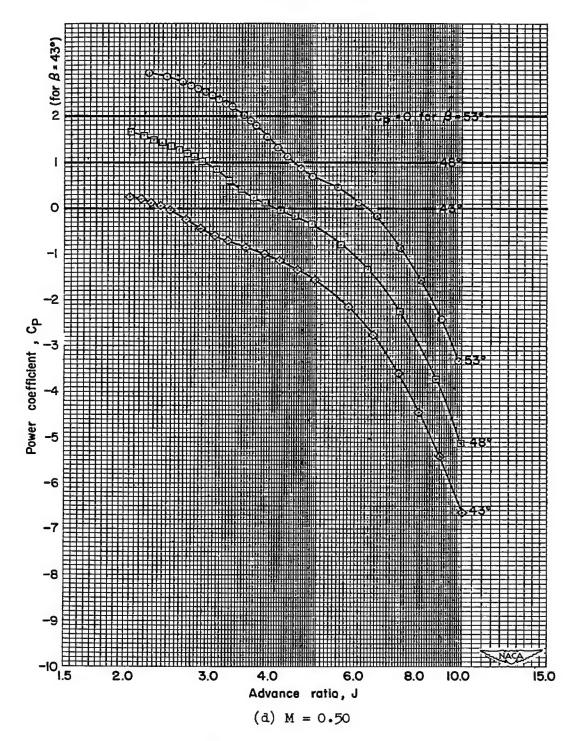
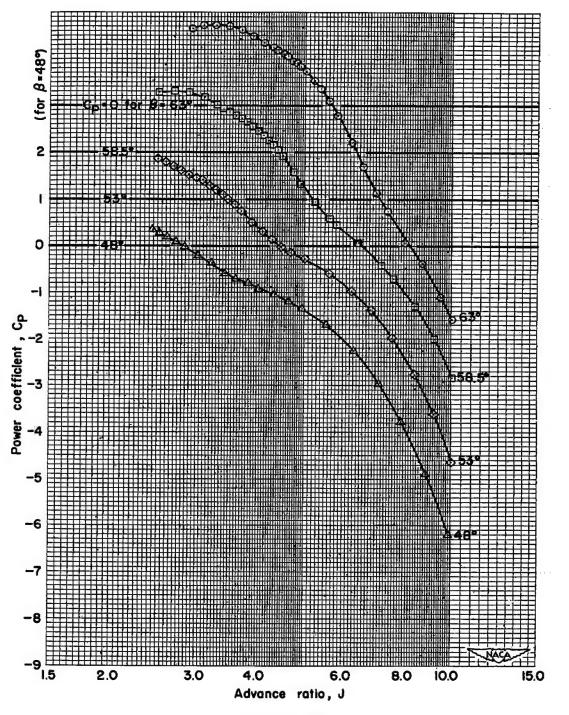


Figure 13.- Continued.





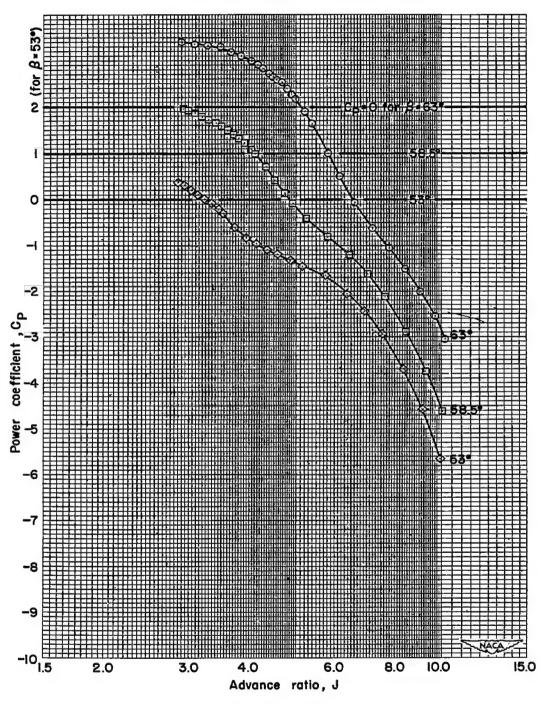


(e) M = 0.60

Figure 13.- Continued.







(f) M = 0.70

Figure 13.- Continued.



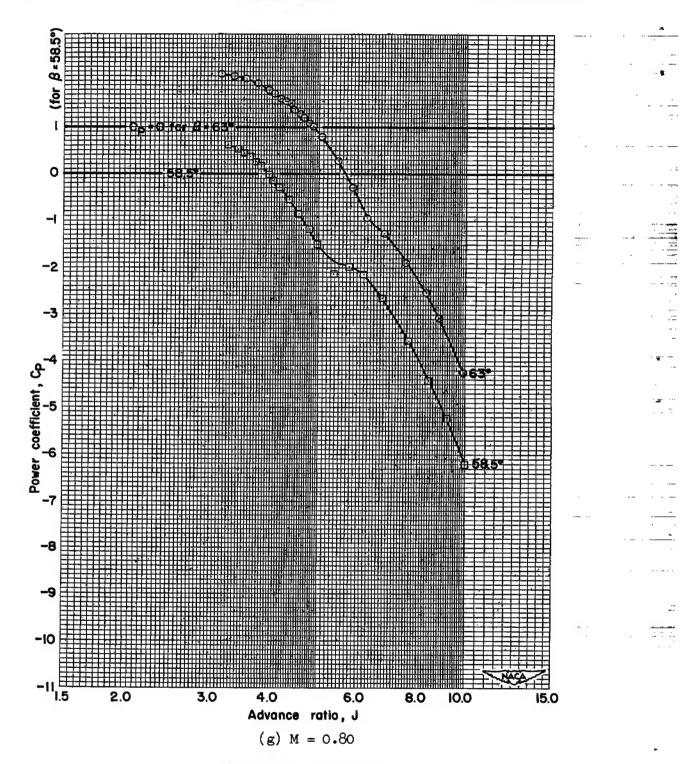


Figure 13.- Concluded.



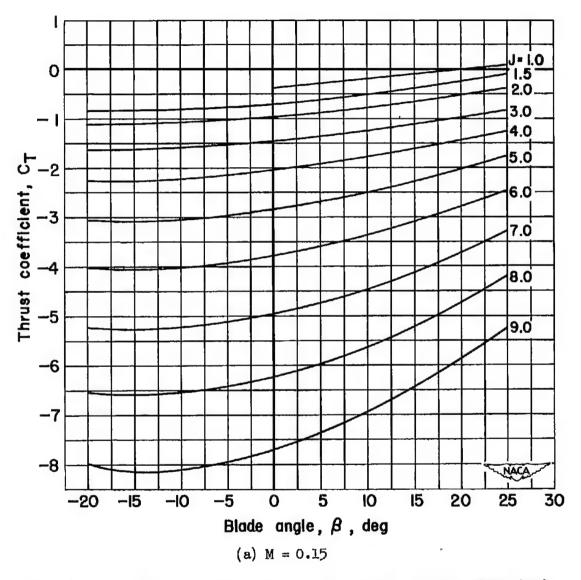


Figure 14.- The effect of blade angle on the negative-thrust characteristics of the propeller.

57

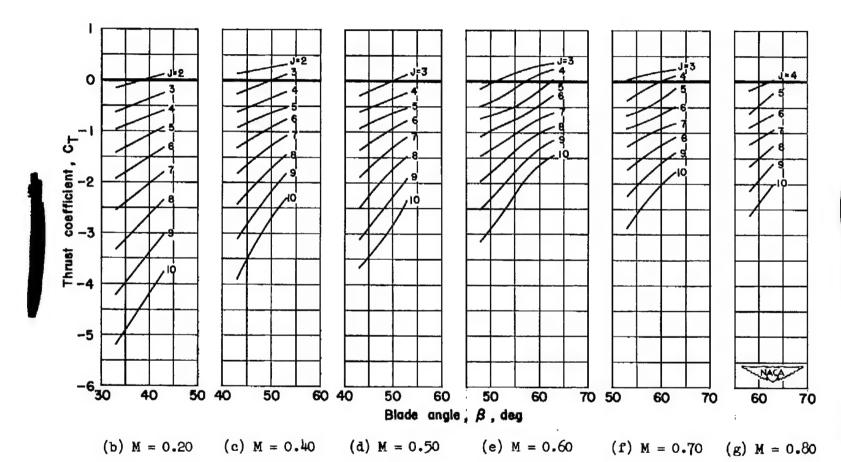


Figure 14.- Concluded.

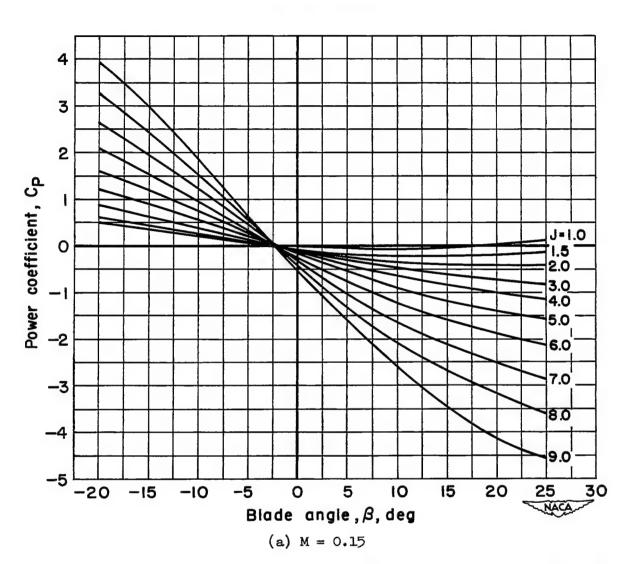


Figure 15.- The effect of blade angle on the power coefficients for the propeller in negative thrust.

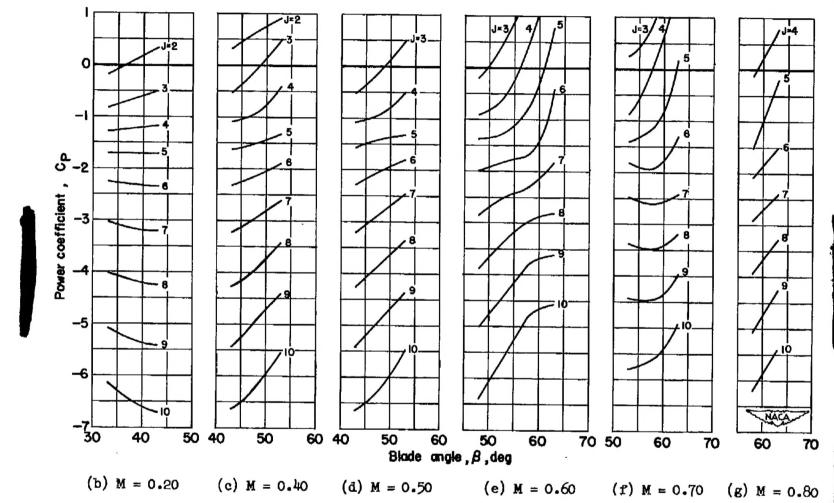
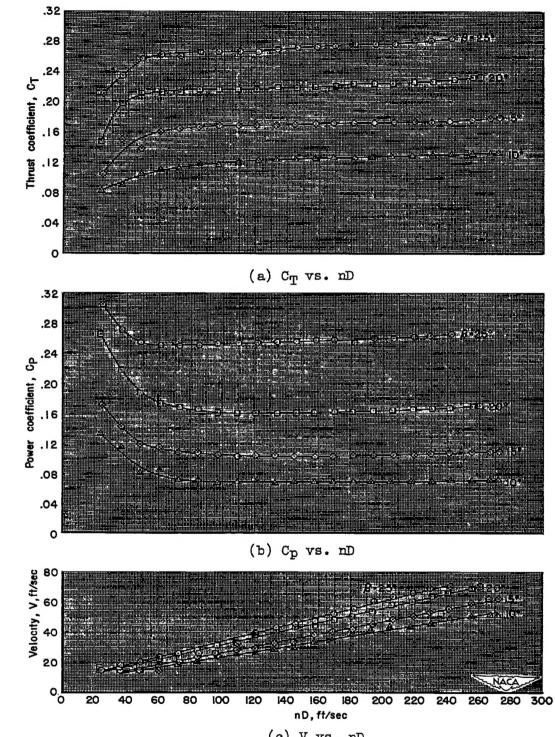


Figure 15.- Concluded.

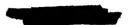




(c) V vs. nD

Figure 16.- Characteristics of the isolated propeller-spinner combination at near static conditions.





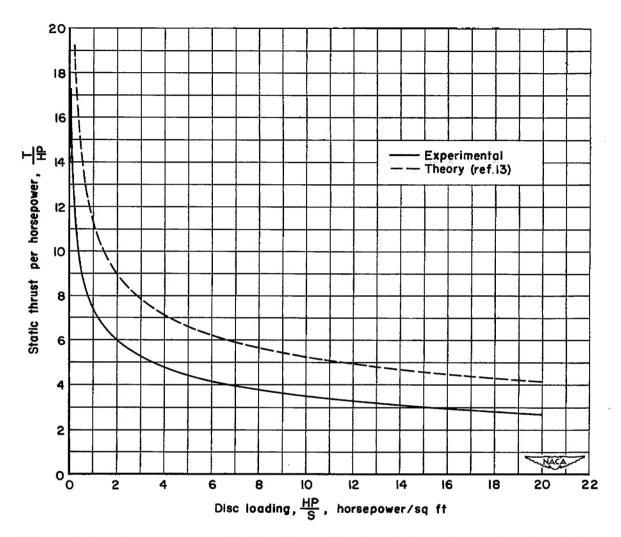


Figure 17.- Comparison with theory of the variation of sea-level static thrust per horsepower with power disc loading for the isolated propeller-spinner combination.



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